POWER PLANT ENGINEERING

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Where Steam Makes Butter

SEPARATELY FIRED SUPERHEATERS AND RECORD SYSTEM ARE SPECIAL FEATURES OF AMERICAN COCOANUT BUTTER CO. PLANT

AS OUR CIVILIZATION leads us farther away from the food products of the farm, we become more dependent upon manufactured articles. This transition is at present taking place rapidly, considering that the food habits of many centuries' duration must be changed. This is due largely to the fact that scientists have proved conclusively that the substitution will result in greater economy without detriment to health in any way. Substitutes for eggs, butter, milk and sugar are common products in the market today; each requires a special treatment in which heat is one of the principal elements.

So it is in the refining of cocoanut oil to be used in the manufacture of Nucoa Nut Margarine, a product of the American Cocoanut Butter Co., whose factory is located in Chicago, that large quantities of steam are used, the pressures or temperatures of which are varied

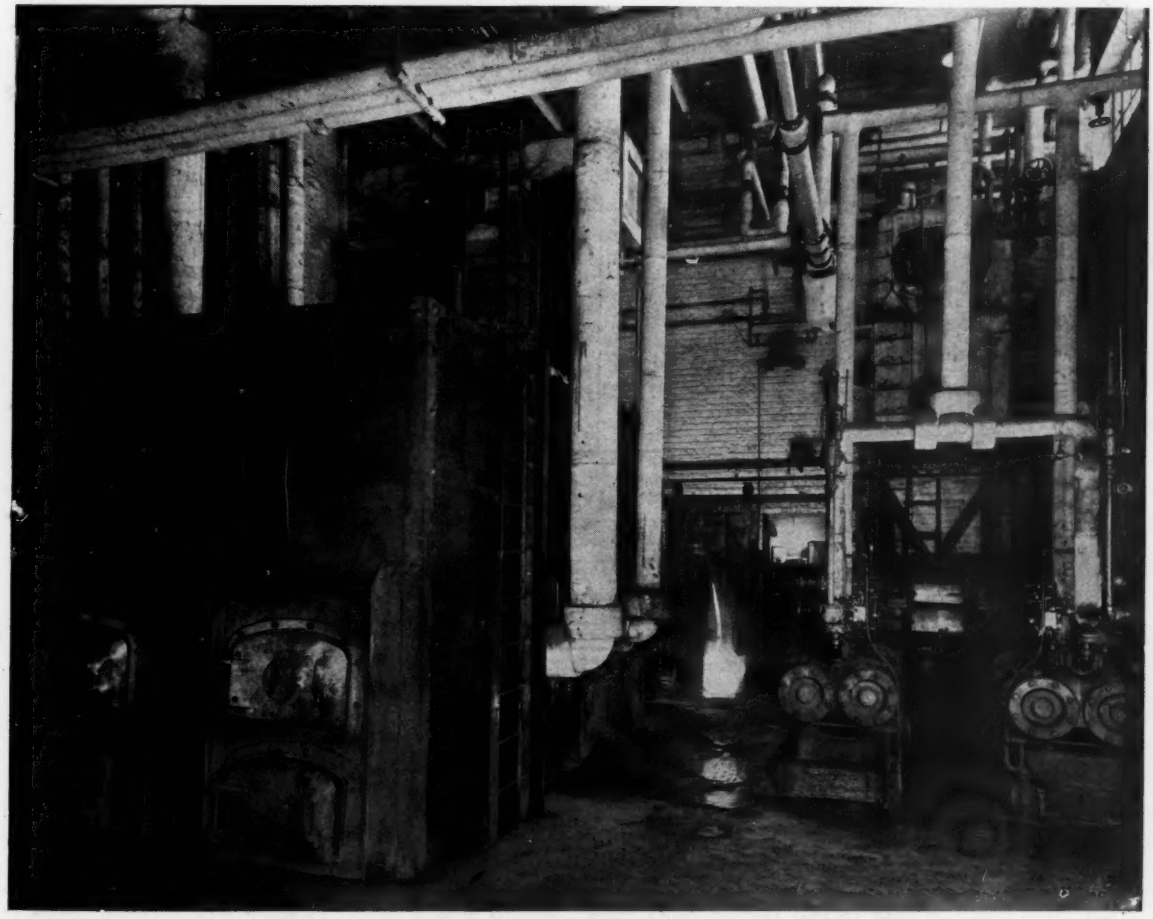


FIG. 1. VIEW IN BOILER ROOM SHOWING SUPERHEATERS, FEED PUMPS AND FEED WATER HEATERS

to suit the requirements of the treatment employed. No attempt will be made here to outline the process of the treatment which carries the oil from the raw product of cocoanut mills to oil free from fatty acids, unpleasant odors and other impurities which in any way would so that steam and compressed air are the only products of the power plant which is located in the basement of the building.

The steam needs of the factory are now supplied by three horizontal water-tube boilers, each rated at 240 hp., with space provision made for one more boiler of the same size. The boilers are served by chain grate stokers driven through eccentric rods and line shaft by belt from a vertical engine or a motor about to be installed as an auxiliary.

Each boiler is equipped with a soot blower designed with steam nozzles extending through the hollow stay-bolts of the water legs.

Steam is generated at 150 lb. pressure, but this is reduced to 80 lb. for manufacturing purposes and part of the output is reduced to 15 lb. pressure at which it is passed through separately fired superheaters where its temperature is raised to 650 deg. F. The construc-

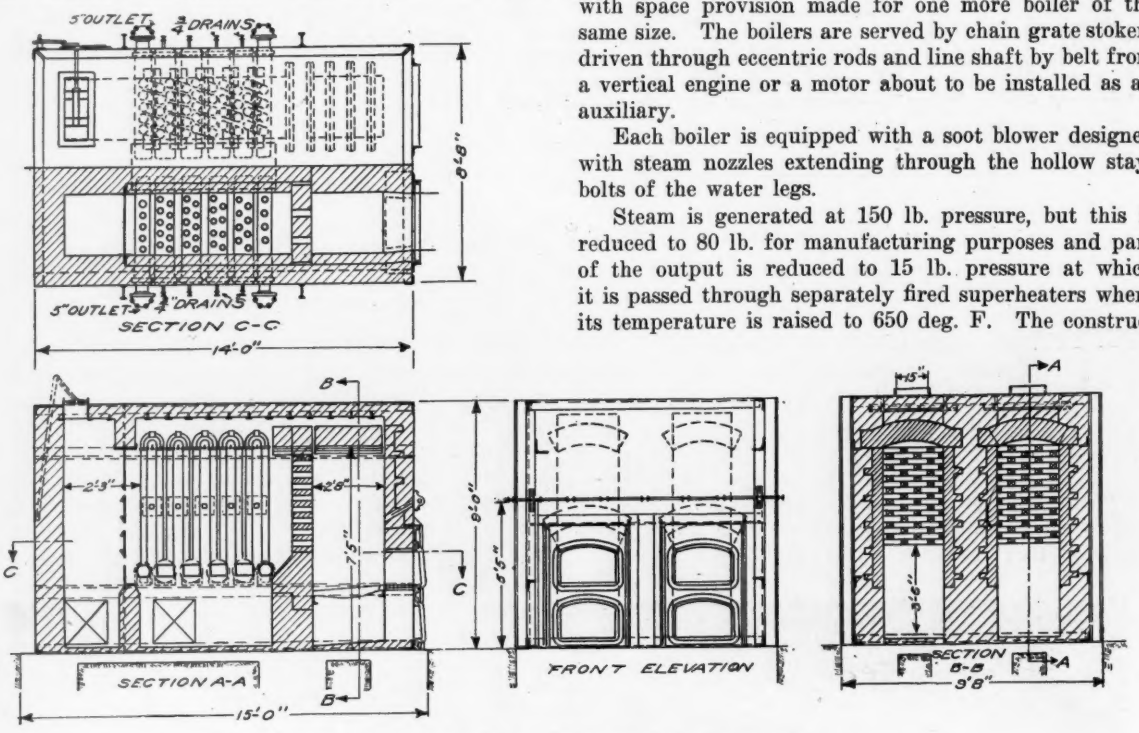


FIG. 2. ELEVATION AND SECTION OF SUPERHEATER

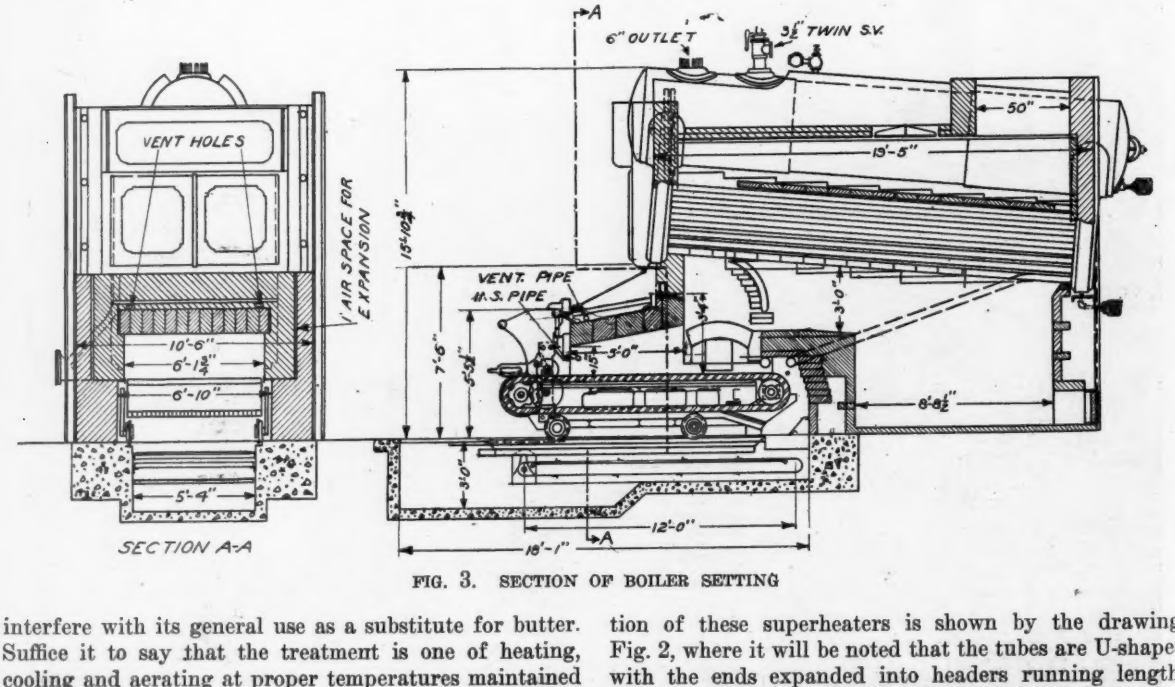


FIG. 3. SECTION OF BOILER SETTING

interfere with its general use as a substitute for butter. Suffice it to say that the treatment is one of heating, cooling and aerating at proper temperatures maintained for definite periods of time.

What little power is used in this factory aside from that for steam pumps is furnished by the central station, tion of these superheaters is shown by the drawing, Fig. 2, where it will be noted that the tubes are U-shaped with the ends expanded into headers running lengthwise of the setting. The two superheaters are in one setting with a solid fire brick wall between. The furnaces have stationary hand-fired grates and the gases

of combustion pass out of the furnace into the heating chamber through a checker work wall of firebrick. Each superheater has a heating surface of 110 sq. ft.

Although an automatically operated damper is placed in the main breeching leading to the stack, its use has been discounted for the reason that the boilers and superheaters do not have the same ratio of load at all times, so hand regulation for each unit is now employed.

An interesting condition in regard to the foundation of these boilers exists which for some time was a puzzling problem and gave severe trouble. The floor of the boiler room is 25 ft. below ground level and although the floor is of waterproof concrete 2 ft. thick, a constant stream of water seeps through the floor into the combustion chamber of all three furnaces. The presence of this spring was at first not known, however, the CO_2 recorder indicated no CO_2 in the gases, no amount of juggling with draft in the furnace seemed to affect the amount of CO_2 and finally one boiler positively refused to draw air through the furnace.

Investigation showed that the spaces between the lower tubes of the boiler were filled solid with rust-like scale and that the combustion chamber floor soon became flooded after the fire was out.

The remedy employed was to put a false bottom in the combustion chamber and drain the water to the sump. When starting the fire, however, the heat was transmitted through the firebrick false bottom to the water, generating steam which was blown out through

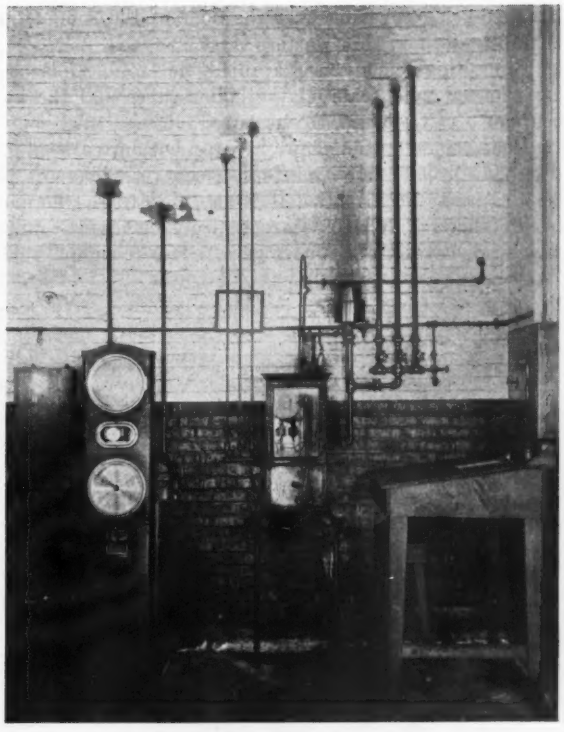


FIG. 4. FEED WATER AND CO_2 METERS

ENGINE AND BOILER ROOM RECORD

American Cocoanut Butter Co.

PLANT_____ DATE_____ BY_____

HOURLY RECORDING GAUGE READING SUMMARIES

		Temp. Superheater			Boiler Pressure			Feed Water Temp.			Rate of Evap.			No. CO2 Readings	Condensor Pump
		Max.	Min.	Var.	Max.	Min.	Var.	Max.	Min.	Var.	Max.	Min.	Var.		
8															
9															
10															
11	Shift No.														
12															
1															
2															
3															
4															
5															
6	Shift No. 2														
7															
8															
9															
10															
11															
12															
1															
2	Shift No. 3														
3															
4															
5															
6															
7															

SHIFT SUMMARIES

	High	Low	High	Low	High	Low			High	Low		
Shift 1												
" 2												
" 3												

DAILY SUMMARY

| | | | | | | | | | | | | | | |

the drain pipe, indicating a considerable waste of steam. An insulating covering over the floor of the combustion chamber stopped this waste.

Since this remedy was applied, no trouble has been experienced with scale on the boiler tubes and the percentage of CO_2 could be measured.

Coal comes to the plant in drop-bottom cars and is dumped directly into reinforced concrete bins of 350 tons capacity from which it is shoveled to the hoppers of the stokers. The bins are entirely enclosed, counter weighted, lifting steel doors give access from the boiler room. Platform dial scales are provided for weighing the coal in wheelbarrows as it is brought into the boiler room.

Ashes are handled by a steam jet conveyor through an 8-in. pipe equipped with two steam nozzles. The vertical lift is 55 ft. to a bin over the railroad track from which the ashes are discharged by gravity through a gate to railway cars for disposal.

Water used for feeding the boilers comes principally from the city mains, although what trap returns are usable are discharged directly to the feed-water heater. Exhaust steam from all pumps is used for heating the water in an open feed-water heater of 100 hp. capacity. It is piped for induction operation and the surplus steam is discharged to atmosphere. The water level is maintained constant by an automatic inlet valve and the temperature of the feed water as it leaves the heater averages 210 deg. F.

Two boiler feed pumps are used regularly with one provided as an auxiliary. The main pumps are each 10 by 6 by 12 in., of the duplex outside packed plunger type with pot valves. The auxiliary pump is 9 by 5¼ by 10 in. of the duplex piston type and is used principally for washing purposes, although the piping is cross connected for boiler feeding as well. Hand regulation is employed for boiler feeding.

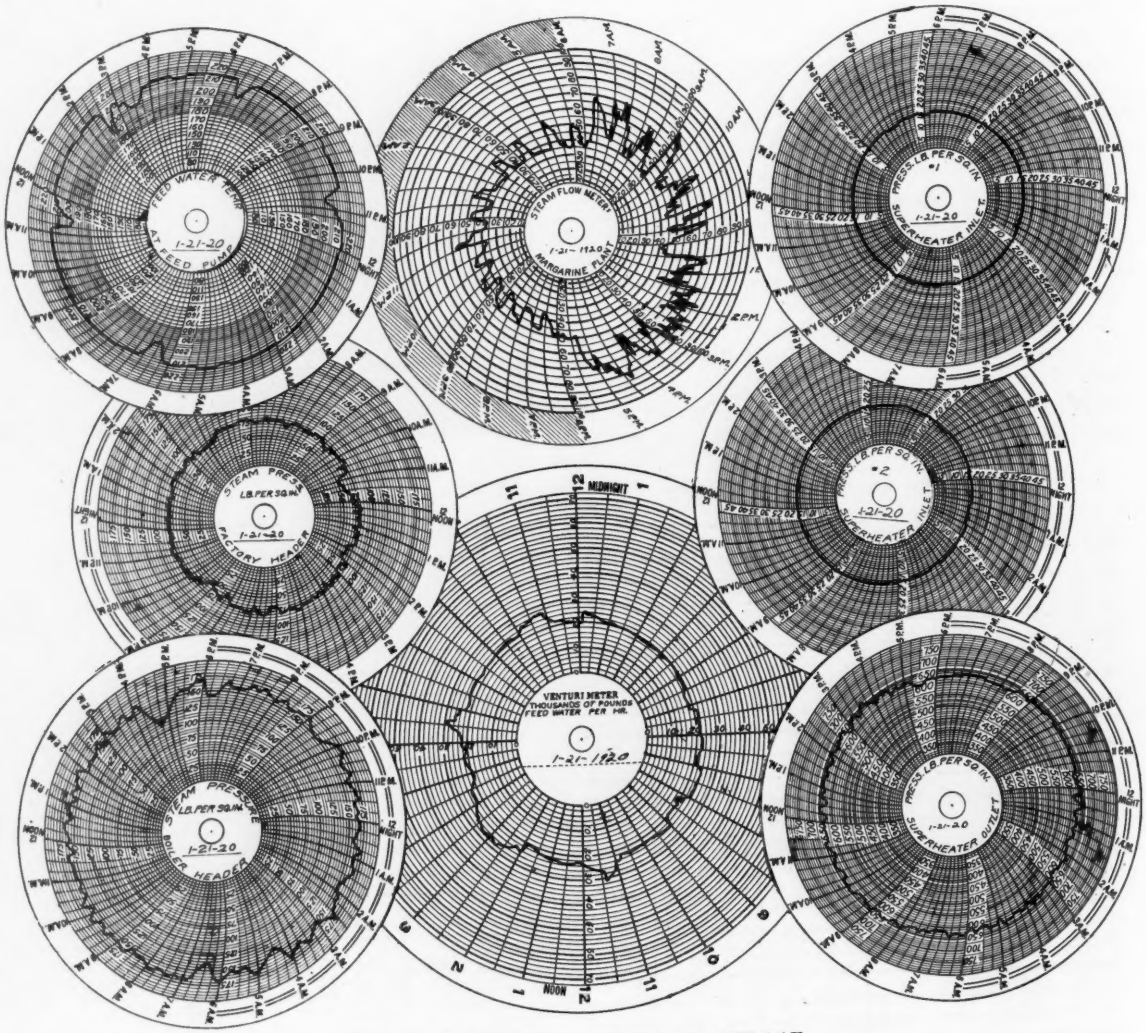

STEAM FLOW METER
1-21-1120
MARGARINE PLANT
FEED WATER TEMP. AT FEED PUMP
1-21-20
STEAM PRESS. LB. PER SQ. IN. FACTORY HEADER
PRESS. LB. PER SQ. IN. SUPERHEATER INLET #1
PRESS. LB. PER SQ. IN. SUPERHEATER INLET #2
PRESS. LB. PER SQ. IN. SUPERHEATER OUTLET
VENTURI METER THOUSANDS OF POUNDS FEED WATER PER HR.
MIDNIGHT
NOON

FIG. 5. SET OF METER RECORDS FOR ONE DAY

Among the interesting features of the plant are the recording instruments, the records from which are collected daily, a set of which for one day are reproduced in Fig. 5. The simple yet complete report sheet, also reproduced, together with the instrument records, gives the superintendent of the factory all necessary data concerning the operation of the plant.

Methods of Using the Engineer's Level

THE OPERATION OF THIS INSTRUMENT IS VERY SIMPLE AFTER A LITTLE PRACTICE, WHEN ONCE THE PRINCIPLES ARE UNDERSTOOD. BY C. L. HUBBARD

THE engineer's level, a simple form of which is shown in Fig. 1, is a very convenient "tool" to have about the plant, and should form part of the kit of the engineer of every large manufacturing establishment. In the factory, its use makes possible the quickest and most accurate methods of shaft alinement. It is of great assistance in laying out extensive systems of steam and return piping and in making additions to the plant where it is necessary to know the levels in order to handle condensation properly. The private sewerage system of a large plant is often quite complicated, and it is frequently necessary to know relative levels of different points, when making extensions, in order to give the proper grade to the chain pipes.

Outside the buildings, there are frequently trenches to be dug, either for water, gas, drainage or heating pipes, and the depth of excavation at different points can be determined only by running a line of levels. There are sometimes roads or drives to be built in the yard or grounds and it may be desirable to calculate the amount of excavation and fill in order to check up the estimate of some contractor bidding on the work. Locating new buildings and extensions requires more or less leveling to find basement grades, which may have an

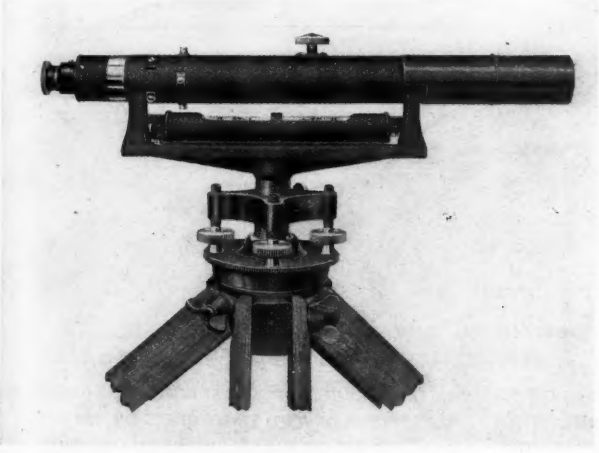


FIG. 1. THE ENGINEER'S LEVEL

important bearing upon cost of excavation, arrangement of heating and plumbing equipment, and also the economical handling of stock. In estimating the head of possible hydraulic developments, it is necessary to run preliminary levels, and also in investigating sources of private water supply from rivers or ponds.

In reality the level is as simple to use as a carpenter's square, after its principle is understood and one has had a little practical experience in setting it up and taking sights. The computations involved are simple problems in addition and subtraction.

For much of the work noted above, a "farm" level may be used, if the expense of purchasing an "engineer's" level is too great. This is not, however, so accurate as the latter, and distances between the stations upon which sights are taken must be less. The construction of the farm level is shown diagrammatically in Fig. 2, and consists of a brass tube having a cap with a pinhole in the center at one end and a piece of plain glass at the other. A short distance back of the glass is a pair of cross hairs, or fine wires, held securely in place, at right angles to one another, with their intersection exactly in the center of the tube, as shown in the first view. The tube is mounted on a vertical spindle so that it may be completely revolved in a horizontal plane, in order to take a sight in any direction after being once set up.

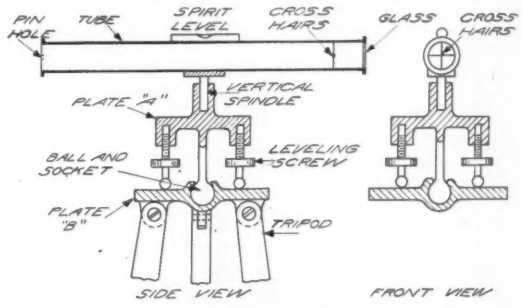


FIG. 2. DIAGRAMMATIC VIEW OF FARM LEVEL

Plate A, carrying the spindle, is held in position by an extension stem, ending in a ball and socket joint, as shown. This plate is also provided on the under side with four leveling screws, the lower ends of which rest on plate B, which in turn is supported upon a tripod.

In setting up the instrument, the three legs of the tripod are firmly planted upon the floor or ground, being spread so as to bring plate B as nearly level as may easily be determined by the eye. The tube is now turned on the vertical spindle so as to bring it directly in line with a pair of leveling screws, and the latter are adjusted until the bubble in the spirit level on top stands exactly at the center, which indicates that the center line of the tube is also exactly level. Next turn the tube in line with the other pair of screws and bring to a level, as before. Turn back to the first pair of screws, and if it is found that the bubble does not now stand at the center of the level, re-adjust the screws until it does. Repeat this process alternately with the two pairs of adjusting screws until the bubble stands at the center of the level while the tube is completely revolved upon the spindle. This indicates that the vertical pivot or spindle is exactly perpendicular and that the center line of the tube will be horizontal for any direction in which it may be pointed. Under this condition it is evident that if we sight through the pinhole and mark the point on some distant object which is apparently cut by the horizontal cross hair, and then turn the tube so as to take a sight on another object, the second point cut by the horizontal cross hair will be at exactly the same level or elevation as that marked on the first object; that is, both are in the same horizontal plane. This simple process is all there is to "leveling," so far as the use of the instrument

is concerned, no matter how large or complicated the work.

The general construction of the engineer's "dumpy" level is the same as the one just described, except the pinhole and plain glass at the ends of the tube are replaced by telescope lenses, so that longer sights may be taken and with greater accuracy. The method of setting up and adjusting the instrument and taking sights, is exactly the same as with the farmer's level.

The engineer's Y level is simply an instrument with more adjustments than the dumpy level and capable of greater accuracy, which is necessary in very important work, especially in case of running long lines where a small error would be greatly multiplied.

The companion piece of the level is the "leveling rod," usually provided with a sliding target. A simple form, adapted to ordinary work and known as an "architect's" rod, is shown in Fig. 3. This has a length of 5½ ft. when closed and 10 ft. when fully extended, and is graduated to feet, inches and sixteenths. In reading a rod of this kind, the lower end is placed upon the ground at the point where the elevation is to be measured, and a sight taken at it through the telescope of the level, which is set up some distance away. The rodman moves the sliding target either up or down on the rod, as may be necessary, until its horizontal center line exactly coincides with the horizontal cross hair in the telescope, as seen by the operator looking through it. The rod is now "read" through the slot in the target, which gives its height above the ground at the given station.

FORM FOR RECORDING READINGS AS THEY ARE TAKEN

1 Station	2 Back Sight	3 Fore Sight	4 Difference	5 Elevation
A	12			0
B	5	2	10	10
C	15	10	−5	5
D	11	3	11	16
E		2	9	25

An enlarged view of a target of this kind is shown in Fig. 4, in which the reading or height is 4 ft. 7½ in. When using this rod with the two sections closed, always read from the bottom, and the arrow on the right of the beveled edge of the slot will give the reading on the scale of the rod, as indicated in the drawing. The scale on the rod in Fig. 4 is only graduated to eighths to make it clearer, while that in Fig. 3 is graduated to feet, tenths and hundredths, instead of inches and sixteenths. For the work of the operating engineer a scale of feet and inches will be much more convenient, although rods may be had either way, as desired.

With the rod shown, heights may be measured up to 5½ ft. at one reading when closed. For greater heights, up to 10 ft., the rod may be extended by sliding the sections apart as shown in Fig. 3.

The reading in this case is slightly different and is illustrated in Fig. 5. Set the small pointer on the target

FIG. 3. AN ARCHITECT'S LEVELING ROD

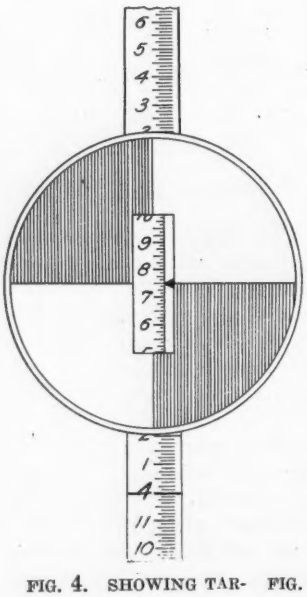


FIG. 4. SHOWING TARGET AND SCALE OF AN ARCHITECT'S ROD

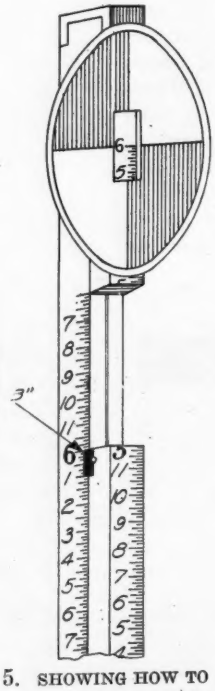


FIG. 5. SHOWING HOW TO READ THE ARCHITECT'S ROD FOR HEIGHTS GREATER THAN 5 FT. 6 IN.

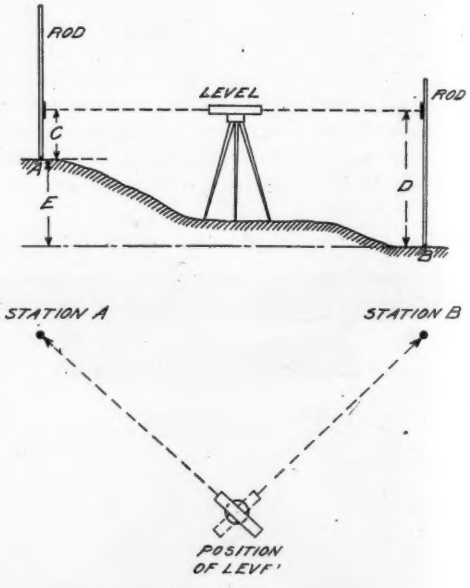


FIG. 6. METHOD OF MEASURING THE RELATIVE ELEVATIONS OF THE TWO POINTS OR STATIONS
FIG. 7. PLAN OF FIG. 6 SHOWING LOCATION OF INSTRUMENT

plate at exactly 5 ft. 6 in. and clamp tightly in place. Then loosen thumb-screw A, Fig. 3, and while holding the lower section of the rod firmly on the ground, slide the other upward until the center of the target coincides with the horizontal cross hair in the telescope, as previously described. Now, instead of reading from the slot in the target, read from the scale on the side of the lower section of the rod, at the upper corner of the small plate indicated by the arrow marked B, Fig. 5. The reading in this case is exactly 6 ft. This is evident because, with the rod closed, the height of the target was 5 ft. 6 in. In Fig. 5 the sections have been drawn apart 6 in., thus raising the target that distance and making its total height 5 ft. 6 in. + 6 in. = 6 ft. from the bottom of the rod. By graduating the sliding section downward, as in Fig. 5, the total height may be read directly from the scale as indicated by arrow B.

Engineer's rods for very accurate work are provided with "verniers" for reading to 1000th of a foot, but this is not necessary in the class of work included in the present article. Special attention has been given to the reading of the rod because this is an important detail.

Leveling, in many cases, requires the measurement of horizontal distances. This is usually done by means of a tape. Engineer's tapes are commonly divided into feet, 10ths and 100ths; but certain kinds may be had graduated in feet and inches, which are usually best for ordinary work. They are of three kinds, linen, metallic and steel. The first of these is likely to twist and tangle and to stretch when wet. When properly cared for,

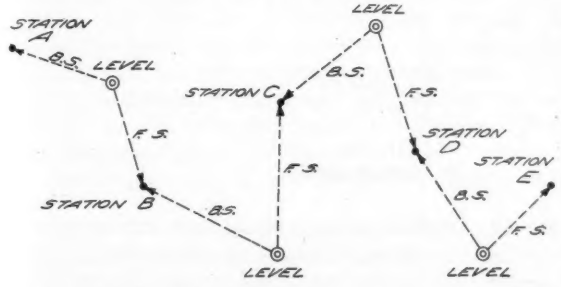


FIG. 8. ILLUSTRATING METHOD OF LAYING OUT STATIONS AND SETTING UP INSTRUMENTS, WHERE THE ELEVATIONS VARY CONSIDERABLY

however, it will answer very well for much rough work. A metallic tape has a linen body with threads of copper or brass running through it. This combination is a decided improvement over pure linen, although likely to stretch and shrink somewhat. It is, everything considered, the best for ordinary work around the plant and sufficiently accurate for most cases. A steel tape is always used for important engineering construction, but rusts and breaks easily, thus requiring special care.

Running Levels

In Fig. 6, let it be required to find the difference in elevation between the points A and B (commonly called "stations"). Set up the level or instrument at some intermediate point, from which a rod placed on both A and B will be plainly visible, and bring it to a true level by means of the adjusting screws, as previously described. Let the rodman hold the rod in a vertical position upon station A and move the sliding target until its center coincides with the horizontal cross hair in the telescope (or tube). The observer or "instrument man" meanwhile signals up or down, with his hand, to the rodman, until this result is reached. The rod is now read, as described in connection with Fig. 4, which gives the distance C, or height of the instrument above the station A. The rodman now places the rod upon station B, and the telescope is revolved upon its vertical axis until it is brought in line with the rod in its new position, and a sight taken upon the target, thus measuring the distance D, which is the height of the instrument above station B. As the height of the instrument is the same in each case, the difference in elevation between stations A and B is evidently the difference in the two sights taken on these points; that is, height D—height C = height E. It makes no difference whether the instrument is set up in the straight line joining A and B or at one side, as in Fig. 7, provided both stations are clearly visible.

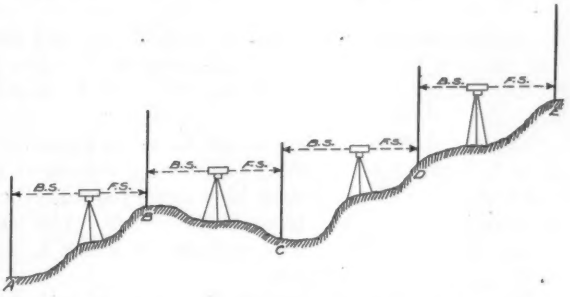


FIG. 9. VERTICAL ELEVATION OF FIG. 8

In running a long level, requiring a number of stations, it is customary to follow the general line of the stations when setting up the instrument, although it is often necessary to depart from this rule in order to avoid obstructions and obtain a clear view of consecutive stations. The first sight or reading taken on station A in Fig. 6 is called a "back sight" and that on station B a "fore sight." The difference in elevation between two stations, as we have seen, is the numerical difference between the back sight and fore sight.

Let us now take up a case where the difference in elevation between the extreme ends of the line is greater than the height of the rod and where the first and last stations are not visible from the same point. A set of stations are marked out so located that numbers 1 and 2 are both visible from one point, also 2 and 3, 3 and 4, and so on to the end of the line. Let this be represented diagrammatically in plan and elevation in Figs. 8 and 9 respectively, in which it is required to find the difference in elevation between stations A and E.

In Fig. 8, it is assumed that the obstructions are such that the relative instrument positions and intermediate stations must be approximately as indicated, while the same are shown in elevation in Fig. 9. The instrument is set up between A and B, and a back sight taken on the former and a fore sight on the latter. Let the first of these readings be 12 ft. and the last 2 ft.; then the difference in elevation will be 12 — 2 = 10 ft. Next set up between B and C and take a back sight on B and a fore sight on C. Let the first of these be 5 ft.

and the last 10 ft., giving a difference of 10 — 5 = 5 ft. When the fore sight is less than the back sight, it indicates a rise in level, and when it is greater than the back sight it indicates a fall in level, both conditions being illustrated in the readings just given and made clearer by an inspection of stations A, B and C in Fig. 9.

Starting with an elevation of 0, at station A, the elevation at B will evidently be 12 — 2 = 10 ft. Then if the difference between B and C is 5 ft., and C is lower than B, its elevation, as compared with A, will be 10 — 5 = 5 ft. If the back sight on C is 13 ft. and the fore sight on D is 2 ft., the difference will be 13 — 2 = 11 ft.; and as D is higher than C, its elevation, as compared with A, will be 5 + 11 = 16 ft. Completing

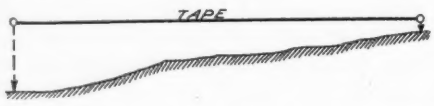


FIG. 10. METHOD OF USING A TAPE ON A SLIGHT SLOPE

the survey, let the back sight on D be 11 ft. and the fore sight on E 2 ft., giving a difference of 11 — 2 = 9 ft., and making the total elevation of E above A, 16 + 9 = 25 ft.

The notes of this survey would be as shown in columns 1, 2 and 3 of the table. When the fore sight is larger than the corresponding back sight, the difference is minus as shown in column 4 opposite C. The last column gives the elevation of each station above A, the starting point in the survey.

When it is necessary to know the height of each station above the first, or starting point, the "Differences" and "Elevations" are computed as in columns 4 and 5 in the table. If, however, it is only desired to find the difference in elevation between the first and last sta-

FIG. 11. ON STEEP SLOPES A SHORT SECTION OF THE TAPE ONLY IS USED AS SHOWN

tions, readings are recorded as shown in columns 2 and 3 of the table. The back sights and fore sights are then added separately, and the difference between these totals will be the difference in elevation of the two stations A and E.

The process of leveling frequently involves the measurement of horizontal distances, as in trenching for steam mains, grading, etc. In measuring distances greater than the length of the tape, first set stakes at each end of the line. Unroll the tape and let the "leader" go ahead with the end marked 100 ft. (or 50 ft., according to its length) until the slack is nearly taken up. The "follower" now holds his end of the tape against the first stake and motions the "leader" into the exact line with the last station, where a stake is set measuring the length of the tape, or 100 ft. The "leader" now goes ahead until the "follower" is brought up to the stake just set and the operation repeated. The number of tape lengths are recorded and the fractional part found in the last measurement added to the sum of the whole lengths.

In measuring horizontal distances over uneven ground, the tape must always be held level instead of being allowed to follow the contour of the earth. This is illustrated in Fig. 10 for a case where the slope is not so great but that the full length of the tape may be used. For steeper grades, it may be necessary to "break" the tape, or use only a portion of it at one time as in Fig. 11. In either case, the raised end of the tape should be brought exactly over the stake by means of a plumb bob as shown in Fig. 12.

For accurate work, wire pins are used instead of stakes for marking the tape lengths. If these are not at hand, and wooden stakes must be employed, a nail should

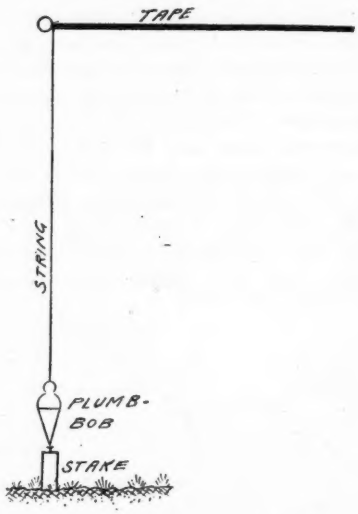


FIG. 12. SHOWING METHOD OF BRINGING END OF TAPE OVER STAKE BY MEANS OF PLUMB BOB

be driven in the top and used as the point to which the measurement is taken.

A following article will take up the practical application of leveling to some of the more common problems found about the plant.

Slang vs. Technic

HE WAS from the East and had seen many exhibitions of the supposed-to-be tough saloons of the West, in the movies. He admitted that he did not have previous experience, but he was willing to work and therefore the boss placed him as a groundman with a traveling gang. Coming back to the city to spend Sunday, he was accosted by the boss:

"How are you getting along?"

"Rather green, but I like the work."

"Oh, you'll catch on all right. By the way, did you folks find any loose joints?"

"Nothing doing in that respect. They are nailed up as tight as a woman's shoe."

J. B. DILLON.

Stoker Furnace for Coal or Oil

Details of Furnace, Changes in Turning from Coal to Oil as Fuel

UNCERTAINTY of coal deliveries at one of the plants of the Erie Forge & Steel Company led to the design and installation of an oil burning system which has features of unusual interest, making possible a change from one fuel to the other in about 12 hr. which is practically the time necessary for the furnace to cool down to a temperature at which the fire brick can be handled with comfort. To make the entire change in the first place, required the shutting down of the boiler only 36 hr.

The original installation consisted of a horizontal water-tube boiler served by an inclined type underfeed stoker, a cross section of the installation being shown in the illustration. The furnace dimensions given are those commonly used for this type of installation where Pittsburgh coal is used. Back of the bridge wall a tunnel was made by taking out some of the filling and building a brick retaining wall. This tunnel extends through both side walls of the boiler setting and into it the oil and steam pipes for the oil burning system lead from the basement through the boiler room floor then to the burner located in holes extending through the bridge wall. For each boiler two burners are installed using steam for atomizing purposes. The holes through the bridge wall diverge in dimensions from 9 by 9 in. at the back to 12 by 18 in. at the front.

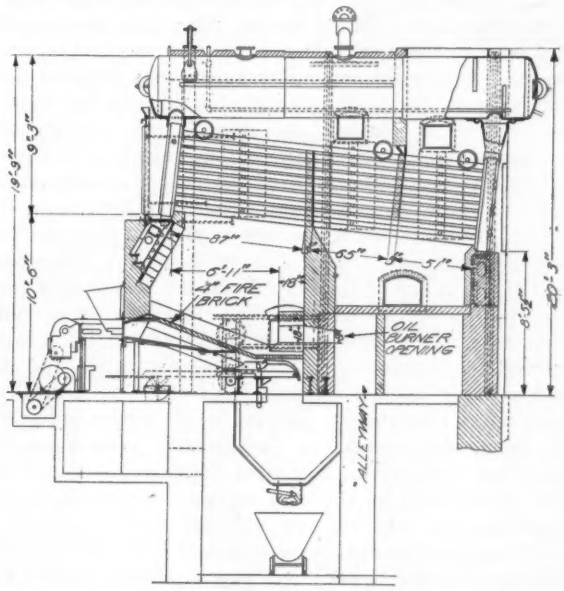
Directly over each recess is placed a deflecting ledge extending out from the bridge wall, the purpose of which is to deflect the air which is rising along the bridgewall, into the body of the combustion place.

Over the tuyeres of the stoker and bridging the retorts is a 4-in. fire brick flooring for the furnace. This covers the entire floor of the furnace with the exception of a narrow opening at the bridgewall under each burner.

With the first installation air for combustion was supplied by a fan installed especially for the burning of fuel oil, but when it was noted that the temperature of the firebrick floor and tuyeres was excessively high, the regular forced draft system used with the stokers was used with exceptionally good results. By this means the supply of air was automatically controlled in proportion to the loads carried, and the air being heated by contact with the hot floor of the furnace, reduced the length of the oil flame perceptibly resulting in better combustion and consequent higher efficiency. The evaporation obtained with fuel oil during actual working tests averaged about 11.5 lb. water per pound of oil.

In changing from oil to coal as fuel, it is only necessary to remove the burners, brick up the holes in the bridgewall and remove the firebrick from the tuyeres. It is the intention to use fuel oil only when coal is not available or more expensive to use.

In the plant are four 400-hp. boilers, three of which are equipped for burning oil in emergencies. These boilers have been in operation since 1917, and many times developed loads equivalent to 300 per cent of their rating for long periods of time, particularly during the war when the factory was worked continuously to the limit of its capacity. During this period no mechanical defects have developed in the boilers even though operated for long periods of continued service without cleaning. This performance is attributed to several features of design such as an effective settling chamber for scale forming materials and corrugated flanges connecting the drums to the headers which prevent the distortion and buckling of headers and tubes under extreme temperature changes. The features which have given such excellent results with coal as fuel will undoubtedly prove as valuable, if not more so, when fuel oil is used, as the temperature changes are likely to be more rapid than with coal.



BOILER SETTING WITH UNDERFEED STOKER REARRANGED FOR BURNING FUEL OIL

For the data from which this article was prepared we are indebted to Ward Stalknecht, of the Erie Forge and Steel Co., and George W. Bach, of the Union Iron Works.

An information service for the benefit of employers of foreign born labor, and for the workers themselves, has recently been established by the Inter-racial Council, Woolworth Building, New York City. The form of this service consists of a slip sheet sent out at regular intervals for which no charge is made. The object of the present series is to check the tendency of the foreign born to return to their native lands under the mistaken impression that prices are lower and living conditions better there than in America. This is done by circulating reports from the foreign language newspapers regarding actual conditions abroad, and by reports from unbiased authorities such as the Red Cross.

The clippings are designed for the use of editors of internal house organs, shop papers, etc., and may be adapted also to use as shop bulletins and posters, pay envelope stuffers, and similar publicity. While helping to stabilize immigrant labor, this service is in line with the constant effort for the welfare of the foreign born by promoting better relations between the various races in America and the native born.

Recent Progress of Power Development in the World*

American Engineering Progress Influences World Power Industry. By L. W. Alwyn-Schmidt

EUROPEAN POWER developments always reflect upon the power development outside of Europe at least as far as the economic side of this development is concerned, technical development having gravitated largely to the American direction. In studying, therefore, the most recent history of new power enterprise outside of Europe, it is necessary to separate carefully between the economic influences emanating from Europe and the technical ones having their principal origin in the United States. This slow ascendancy of American technical influence must be ascribed to two reasons. One is the comparative similarity between the conditions in the United States and those in the countries outside of Europe, the other is the inability of Europe to supply power installations outside of Europe during the war. The bulk of the orders consequently has gone to the United States. American influences, of course, are strongest in the new world but they can be clearly traced now also in Eastern Asia and Australia.

Canada is one of the best, if not the best market for American power machinery. The close intellectual and commercial intercourse between the two countries is furthering the development of engineering knowledge in each country upon a common basis and this naturally must affect construction policies in the power industry All power development in Canada, therefore, concerns the power industry in the United States as much as if it took place right in our own market. Under this circumstance, we can look only with satisfaction upon the enormous progress that is made just now in Canada with reference to rural power development. Canada desires to bring in the reach of its farms electrical power at prices comparing favorably with the rates enjoyed by the city dweller. This desire is now slowly evolved into an economic principle and we may expect during the next few years an enormous increase in electrical power activity in the dominions of our northern neighbor. Incidentally this should be a warning for our own legislators. If Canada is to equip its farms with electrical power, we shall have to do something similar in our own country or we are running the danger of being outdone by Canada.

South American Power Development Still Feels Effects of War

South American development still proceeds only comparatively slowly. It is not exactly a compliment to our own prowess but there can be no harm stating that the United States has lost a great opportunity in South American power development during the last few years and is apparently not willing to condone for the original mistakes. During the twenty years before the European war, South American power development had been the reflex of European development. Not only was all machinery practically of European origin, but European money had financed the enterprises at, by far, their largest extent. South America, no doubt, was rich enough to finance its own power developments; but the South American had not yet learned to invest his money in the public utilities of his own country, preferring instead to seek such investments as the bonds of the city of Paris and others that appealed to him. European financiers, on the other hand, made good profits out of developing South American power properties. These not only paid very good interest, but provided also an income for the power industries of the European nations. One can follow quite easily the work of these financial interests all over the South American continent. In the Northeast English capital prevails; in the South and West, German and French capital is sharing the spoils. It is said that the Germans have lost much of their South American connection and a few of the leading German enterprises are now in American hands. But outside of these sporadic attempts, little was done by America to make use of this most wonderful occasion to secure a foothold in South American power development. The opportunity for developing an American power interest in South America is today even better than during the war. For the first time in the history of public utilities financing in South America, South American capital has shown itself willing to take a share. There is a chance just now to construct power centrals in South America with the bonded investments of the South American investor and to operate them with operating capital found in the United States. This has been tried already very successfully in the realm of South American railroad investing and there is no reason why the experiment should not be repeated with reference to power development.

The main trouble at present seems to be that the projects are not always large enough to appeal to the American financier. He is, as a rule, not attracted by small enterprises requiring an investment of a matter of $100,000. These, however, are just now very frequent in South America and they offer an excellent chance for an enterprising power engineer who is able to drum up a little capital. The erection of small central stations, driven with Diesel engines and supplying power to a city of limited size and its surroundings is one of the most profitable enterprises that can be thought of, and there are literally hundreds of locations where such stations would be welcome and would find the required popular support. This is a matter well worth looking into. Hydro-electric enterprise also offers many excellent opportunities. South America is poor in coal, and the oil resources are not yet sufficiently developed to be accessible in every instance. There is also a feeling in South America that with hydroelectric development where it stands now, it is preferable to any other form of power production where water power can be obtained. Each state, therefore, has given close attention to the problem of water power and there are, along the coast and also the interior, available a great many sites that would come handy for this purpose. The trouble seems to be that many of these sites are too far removed from the principal centers of consumption. This makes neces-

*This is the second of two articles on this subject by Mr. Alwyn-Schmidt and forms a continuation of his previous articles dealing with similar subjects.

sary expensive transmission lines which cannot be erected without the aid of large capital. But in Chile there are a great many smaller power sites in good reach of the market that wait for medium capital.

Asiatic Power Field Offers Interesting Study

Turning to Asia, there is much, just now, in that part of the world, of interest to the American power engineer. The war has given to the American power industry quite an exceptional standing in Eastern Asia. Before the war, this field was practically in the hands of English and German electrical firms. The war has raised a good deal of antagonism against German producers of power machinery which, while not always completely justified by the facts, nevertheless has practically destroyed German influence. Owing to the inability of the English manufacturers to supply equipment, orders had to be placed in the United States and the deliveries having been made promptly and the goods having turned out satisfactorily, America has gained much in prestige. There are today two distinct fields of development in the Asiatic East. The one, including Japan and the Japanese sphere of influence upon the Asiatic continent, is practically controlled by Japan. The other, which comprises most of the Chinese empire and Siberia, is now open for international competition.

The Japanese power development most likely will have received a very severe check by the recent financial collapse, the reasons of which seem to have been only imperfectly understood in this country. Students of Japanese finance and economic life had already cautioned some time ago, pointing to signs of over-speculation in Japan. The situation is really not new to that country, as it had passed through a similar experience several years ago after the Russo-Japanese war. Japan found its great industrial opportunity during the war. Freed practically from foreign competition in the domestic market and finding a ready reception for many of its industrial products in the export market, its industries have expanded very rapidly. There is hardly an industrial branch today in Japan that has not doubled in capacity during the last five years and industrial production has exceeded all records. Naturally, this could not be accomplished without increasing also the power supply of the nation. Electrical enterprises, therefore, have been formed in great number and financing seems to have been carried on in rather a wild manner. Smaller companies were combined and on the surface at least the Japanese power industry appeared to be rather prosperous. The equipment of the new power stations was mostly of Japanese make. It is now generally conceded that the Japanese engineering works are very well able to build a fairly suitable equipment for ordinary purposes. It is to be doubted, however, whether the industrial development has reached the state, required for the construction of power machinery of the character required for our present time. Periods of strenuous industrial activity are apt to over-exert power equipment and only the most highly constructed article can withstand for any length of time the wear caused by the war activity. We have had this trouble in our domestic market and one can understand, therefore, the effect of the war upon Japanese-built equipment. Much of the Japanese power equipment, therefore, seems to have reached a point where its further employment became inadvisable in the interest of effective operation and during the course of the last year attempts have been made by various Japanese interests to secure American electrical and other power equipment, to replace the worn-out Japanese or other older machinery. The occurrence is practically identical with the experience of several years ago. A stringency suddenly arose in the flow of capital and the American manufacturers being unwilling to strain their credits, a temporary stop was the outcome. This now seems to have turned into a complete check. The effect of the recent crisis upon power development in Japan is not quite apparent yet, but there is reason to believe that Japanese firms will be less interested in future in development work on the Asiatic continent until they have settled the affairs of their domestic market. It would, however, be wrong to take too serious a view of the situation. Japan has recovered very rapidly after its crisis following the Russo-Japanese war and with its expanding export markets it will find means to correct the present situation. In the meantime caution seems to be advisable.

Japanese influence in China has expanded during the last year principally upon the territories secured by the occupation of the former German concessions. Here the Japanese found a rather well sized German electric power station, the service of which was largely extended until it now serves 50,000 lamps, approximately. The power is required for Japanese governmental purposes and for the use of the great number of factories in and around Tsingtau. China is placed in many respects as to fuels very similarly to South America. There are coal deposits in China which are worked but the difficulty of transporting coal over long distances, especially at the present very disturbed times, makes rather risky their use for power production upon a large scale. The Chinese power stations, therefore, are using Diesel engines in preference to any other form of power generation and find the application of these machines the most practical under the circumstances. Shortly after the outbreak of the war when European supplies failed and American engines were not obtainable, the Chinese engineering works built their own Diesel motors. These were constructed practically entirely upon European lines and have proven successful in actual operation. A recent U. S. government report from China gives a rather interesting example of the engine equipment of a leading Chinese power station, that of Kwantung, located in the city of Canton. This station is equipped as follows:

Three 350-kw. sets—Lyons. Atlas Diesel engines; American generators.

One 200-kw. set—Hicks Hargraves Diesel engine; Vickers generator.

Six 140-kw. sets—Two Williams and Robbins Diesel engines; Dick-Kern generators; three Mirriles Diesel engines, two B. W. E. generators, one Siemens generator; one Sulzer Diesel engine, one A. E. G. generator.

Four steam 120-kw. sets.

One 110-kw. set—Hip Tung Wo engine, belt-driven generator.

The Canton plant is a Chinese enterprise. The Foochow Electric Co.'s plant which is one of the best known electrical enterprises in China is also Chinese. This

company was formed in 1910 and has been doing well ever since. It has a capital of nearly one million dollars and operates two 1000-kw. turbines. A somewhat amusing sidelight on Chinese distribution conditions is supplied incidentally, in a U. S. consular report where it is said, that the Foochow Co. has been compelled to install a type of Japanese-made electrical meter, heavily protected against tampering. These are constructed in a manner so as to change the entering current from 220 to 110 v. as supplied to the lamps. This system prevents tampering with the current on either side of the meter. The current sold through this meter is offered at a lower rate to induce the consumer to use the new meter. Tapping of wires apparently has been a very much up-to-date sport in China as well as in Japan and the introduction of the new meters may possibly prevent it. The Foochow Co. is well supplied with American power equipment, but the war has somewhat increased Japanese influence and the more recent distribution of material has been of Japanese make.

Australian Power Industry Very Active

One of the most compact and most scientifically employed power centers of the world is New Zealand. New Zealand has today a total capacity of 43,899 kw. which is produced by 66 centers, 26 of which are using water power. Only 10.5 per cent of the total power generated in New Zealand is in private hands while all the rest is either governmentally generated, or owned by local authorities. This fact, the government hopes, will finally permit a complete inter-connection of all electrical power generation in the islands with a view to reduce the auxiliary margin to 10 per cent or slightly more. All available power in such case would be used most economically and it would be possible to make power accessible to the agricultural districts which at the present time are still not as satisfactorily served as might be desired. The largest of the government-owned stations is that on Lake Coleridge which was completed during the war after many difficulties. It supplies now 8500 kw. but provisions have already been made for doubling the output. The work of enlarging the plant is proceeding very favorably and tenders for the supply of the necessary machinery will be issued in a short time. New power stations are also under consideration in Tasmania and in New South Wales where service will be provided for the smaller towns.

During the war much American power equipment has been introduced into Australia and New Zealand. This equipment has been found of good value and while there is a distinct tendency today all over Australasia to let as much of the construction business as can be go to England, there is a possibility of orders also being placed in the United States.

A Catechism on Heat Saving

Vital Questions Regarding Heat Insulation Intelligently Discussed. By Austen Bolam

WHEN YOU bought your pipe covering there were several courses open to you. The first and most obvious was to shop around for the cheapest (lowest cost) covering that would apparently comply with the conditions. Many engineers, for instance, are strong believers in 85 per cent magnesia. They will use no other covering, but they are apt to balk at the expense of a "double thickness" covering even though it may be a paying investment. Other buyers are consciously or unconsciously prejudiced in favor of other coverings, but in neither case does the average engineer actually have the correct "dope" on this important subject. He just "prefers" a certain kind of covering because he "believes" it is the best.

Differences of opinion are perfectly justifiable, but there should be no mere "opinion" on a subject where the facts are so easily ascertainable. For instance, can you answer these plain questions in regard to your pipe coverings?

1. What pipe covering do you use and why?
2. How efficient is it today?
3. Is it thick enough for the steam pressure you are now using?
4. In what physical condition is it?
5. Has it deteriorated since it was put on the pipes?
6. How much coal does it actually save you per day—month—year?
7. Have you actual figures to prove the fact, or do you only hope it saves coal?
8. What do you actually know about your pipe coverings?

Referring to this list of questions, No. 1 must, of course, be answered personally. I am not in this article going to institute comparisons between different pipe covering materials. But when we come to No. 2, what have you to say?

How Efficient is Your Pipe Covering Today?

Suppose, for instance, you covered your pipes 10 yr. ago with a certain kind of covering, is it saving all the heat that could possibly be saved? Has it ever done so? This leads to question No. 3.

Is Your Covering Thick Enough for Your Present Steam Pressure?

No sane man wears a summer suit in winter. Even dogs and horses put on extra covering for the colder season. Do you treat your steam pipes as you would your horse and "blanket" them according to the temperature, or do you just know your pipes are covered and let it go at that?

In a certain plant, a 1500-ft. outdoor pipe line failed to deliver sufficient steam. It was covered with a single thickness covering, despite the protests of the original pipe covering contractor, who lost his contract by refusing to be responsible for the result. However, the covering was applied by another man as ordered, but the first cold spell put the entire line out of business. Double thickness covering was then applied, involving considerably more expense than would have been the case at first and the result was entirely satisfactory.

In yet another instance, a large plant was about to

order another new boiler in order to increase its steam production. A covering contractor happened along who pointed out that the trouble was not steam shortage but heat wastage as shown by excessive condensation. The thickness of the pipe covering was increased and the cost of the new boiler was saved.

What is the Physical Condition of Your Covering?

This question often puzzles both the engineer and the plant owner and superintendent, because the painted, outer canvas cover looks good. Does it follow that no change has taken place beneath?

Let me tell you of one or two instances which prove that not all pipe covering is as good as it appears from the outside.

A few years ago, in a big steel plant, there was an 18 or 20-in. main, extending the entire length of the boiler house. Of course, it was covered, but with what nobody knew nor cared—it was covered—that seemed enough. It happened, however, that this same pipe made a convenient gangway for workmen who wanted to walk along the line of boilers. Consequently, any virtue which the covering originally had was soon pounded out of it by heavy hob-nailed shoes. Still, the covering was there. What more could you want? It did at last, however, become necessary to remove some sections of it for repairs to the pipe and then the true condition was revealed.

Except for the canvas wrapping, the top of the pipe was bare. The disintegrated insulating material had gradually sunk down and formed a "bag" below the pipe. As a heat saver it was a pure fraud but, although the custom of walking along the pipe had long been abandoned because of the heat, it never seemed to occur to anybody that all this heat meant sheer waste of coal.

In another case an engineer had asked for a high grade of covering. A clever salesman switched the order to another brand. It was applied to the pipes but it contained a certain percentage of organic matter which, first, began to char and then, to shrink away from the pipes. When the canvas outer wrapping was removed a year or so later, cracks 1 in. wide, or more, were found along the whole line of longitudinal joints while there was ample space for two fingers between the covering and the pipe.

Such a covering is of little more practical value than so much chicken wire but there is still a great deal of such "insulation" in use—simply because it is nobody's business to test it out.

Has Your Covering Deteriorated Since it was Applied?

This is largely answered by the preceding, but the real answer is up to the engineer in charge. Examining your pipe coverings at periodic intervals will keep you posted and is just as essential as inspection of any other part of your equipment.

FIG. 1. LEFT: OLD CEDAR ST. POWER STATION, CLEVELAND, IN PROCESS OF DEMOLITION AFTER 20 YR. OPERATION. RIGHT: MAGNESIA PIPE COVERING REMOVED FROM OLD CEDAR ST. PLANT AND RE-APPLIED ON A NEW JOB

How Much Coal Does Your Covering Actually Save You?

It is surprising how few engineers can give even an approximate answer to this question. The pipes are covered, so they must save heat, but there are few coal saving tables available, and most of them are too involved for everyday use. Besides, a fellow has to have some leisure, and running a steam plant all day is no picnic anyway. However, there is one positive test of

the heat saving value of insulation which is always open for trial. How are your steam traps?

Busy steam traps mean excessive condensation which again means coal wastage, because, for every five pounds of condensation a pound of coal has gone down the sewers. Even if the condensate is returned to the boiler, there is still a heat loss of anything from 150 to 300 deg. F. between the steam temperature and that of the return.

When a large steel plant in Alabama was first put into operation, it was run for a very short time with bare pipes. Condensation amounted to 30 lb. per minute,

FIG. 2. PRIOR TO COVERING THIS 2500 FT. OUTDOOR STEAM MAIN WITH 85 PER CENT MAGNESIA IT COULD NOT BE OPERATED AT ALL BECAUSE OF EXCESSIVE CONDENSATION

equal to a waste of 6.5 lb. of coal. Covering with 85 per cent magnesia reduced this condensation to 1.5 lb. per minute. Figured on a coal basis this saving amounted to 1314 tons of coal a year—enough to supply 150 average homes with heat for an entire winter.

If your condensation amounts to as much as 10 per cent of your steam production, it is a certain sign of waste. A factor of 5 per cent can be easily maintained by proper covering.

Have You Figures to Prove Your Coal Saving, or Do You Only Hope Your Covering Saves Coal?

Many power plants have full records of coal consumption, CO_2 evaporation, gas velocity, ashes and other operation details, but in a long experience, I have found very few which have any figures at all on the insulation value of their pipe coverings.

"Faith" was defined by the small boy as "something you hopes it is, but you're 'fraid it ain't." This definition would, I am afraid, define pipe covering to the majority of users. You can rarely interest an engineer in the subject. Like the Tar-baby, the pipe covering "ain't say nuffin'" and gets not a cent's worth of consideration. A steam or water leak, a squeaky part of the machinery, calls for instant attention, but a heat leak of hundreds of dollars may go on for years without notice.

What Do You Actually Know About Your Pipe Coverings?

This isn't an "Irish compliment," but a bid for information. I am interested in finding out—not what you hope or believe or have been told, but what do you really know about heat insulating material? How and why does it save heat? Why is one covering better than another? Which is actually cheaper—a low-cost, low-grade covering or a high-priced, high-grade one?

Every day or so, I pick up my paper and read that "coal has gone up again." Doesn't this suggest that a covering which may have been a perfectly good investment 10 yr. ago when coal cost was next to nothing may be only half a protection with coal "way up?"

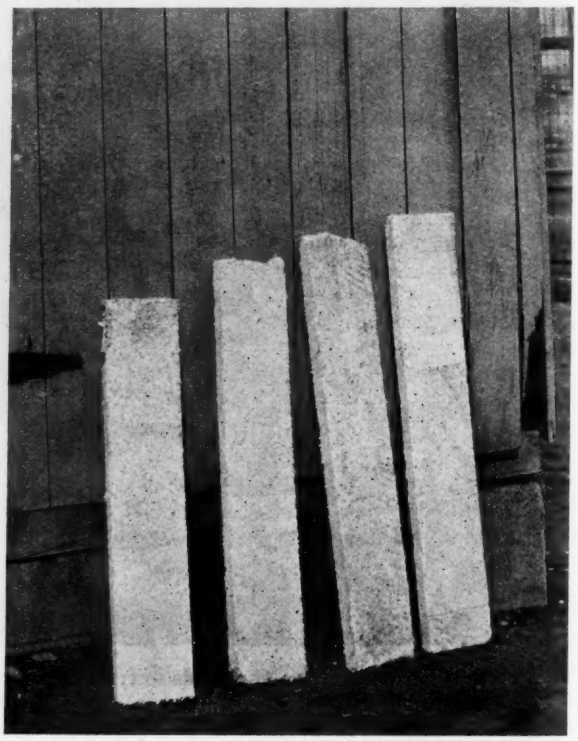


FIG. 3. MAGNESIA BLOCKS SALVAGED FROM LAKE STEAMER "WESTCOTT" AFTER 24 YR. SERVICE AND 4 YR. UNDER WATER. STILL IN PERFECT CONDITION

Here is a little table I have borrowed from the specification of the Magnesia Association of America which shows the varying thickness of covering needed to save the most money at various coal prices and steam pressures. It is worth studying carefully and it clearly points out one important fact—as coal costs or steam-pressures rise, a greater thickness of covering is necessary, to protect your increased investment.

The thicknesses given in this table are the proper thicknesses for the maximum net saving for each condition.

They are based on a period of service of 8760 hr. per yr. Where pipes are cold part of the year, multiply the cost of coal by the number of hours per year pipes are hot and divide by 8760; use the value instead of the actual coal cost. Twenty per cent of the cost has been allowed as the cost of application, and 13 per cent of the total cost for the annual fixed charges (6 per cent interest, 5 per cent depreciation, 2 per cent miscellaneous). The value of the heat-losses used in calculating the net savings are based on a series of experiments, covering a period of three years, made for the Magnesia Association of America by the Mellon Institute of Industrial Research of the University of Pittsburgh.

The table below is for use in plants where costs are not accurately known. It is based on average conditions. In transforming the steam-cost to coal-cost, it has been assumed that 75 per cent of the cost of steam is coal cost, that one pound of coal will evaporate seven pounds of water, and that each pound of steam contains 1000 B.t.u. above the feed-water temperature.

THICKNESS IN INCHES OF "85 PER CENT MAGNESIA" FOR MAXIMUM NET SAVING

	Coal at $3.00 per ton							Coal at $4.00 per ton							Coal at $5.00 per ton							Coal at $6.00 per ton						
Size Pipe Inches	½	1	3	6	12	24	Flat	½	1	3	6	12	24	Flat	½	1	3	6	12	24	Flat	½	1	3	6	12	24	Flat
Hot Water 175° F.	1	1	1	1	1	1	1	1	1	1	1	1	1	1½	1	1	1	1	1	1	2	1	1	1	1	1	1	2½
Steam 5 lb.	1	1	1	1	1	1	1½	1	1	1	1	1	1½	1½	1	1	1	1	1	1½	2	1	1	1	1	1	1½	2½
Steam 100–200 lb. 200 lb.–400° F.	1	1	1	1	1½	1½	2	1	1	1	1½	1½	1½	2	1	1	1	1½	1½	1½	2	1	1	1	1½	1½	1½	2
Superheat 200 lb. 500° F.	1½	1½	1½	2	2	2	3	1½	1½	2	2	2	2	3	2	2	2	2	2	2	3	2	2	2	2	2	2	3
Superheat 300 lb. 600° F.	2	2	2	2	2	2½	3½	2	2	2	2	2½	2½	4	2	2	2	2½	2½	2½	4	2	2	2	2½	2½	2½	4

Turbine Lubricating and Oiling Systems*

Lubricants to Be Used and Their Care

LUBRICATION is an extremely important point which has been given careful attention by operating engineers, particularly in the operation of modern, high-speed turbine equipment. The tendency of manufacturers, in the design of bearings, has been towards the operation of lubricating oils at much higher temperatures. Such conditions necessitate the use of oils which are suitable for the individual requirements and which must be given such attention and treatment

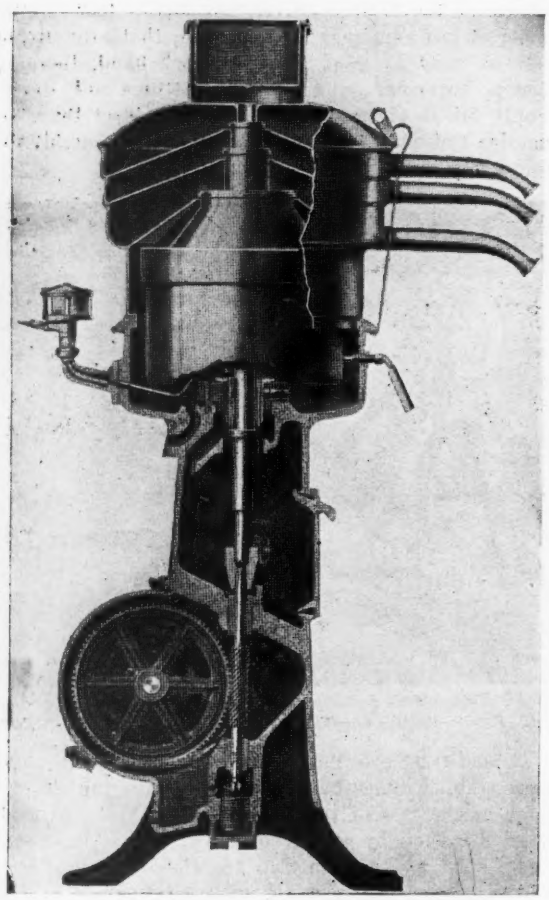


FIG. 1. SECTIONAL VIEW OF OIL PURIFIER

as will minimize trouble in the practical operation of the unit. Experience indicates that the lubricating properties of oil deteriorate under the influence of heat, and when brought into intimate contact with water and air, as occurs under working conditions. These various actions bring about a gradual breaking down of the waxy content into a coagulate or sludge of a brownish color, insoluble at ordinary temperatures in the remaining hydro-carbons, which are the vehicles of the waxy or lubricating agent in solution in the oil. This sludge with its precipitates, if not removed, adheres to the piping of the oiling system and often obstructs the flow of the oil.

*From report of Committee on Prime Movers, N. E. L. A.

The quality of the water which accidentally comes in contact with the oil, due to leakage or sweating of pipes, affects very materially the formation of sludge. Acids accelerate this action, and alkalies aid in emulsifying the oil. The design of modern turbines provides for a storage of oil directly in the machine, with pumping, circulating and cooling systems which are independent for each unit. Such arrangement ordinarily provides for a relatively limited capacity of the oiling system so that it is forced through a rapid cycle of operation. This, in connection with high bearing pressures or abnormal temperatures, tends very rapidly to deteriorate the oil, which is not given sufficient time to settle, clarify and purify. The operating practice today consists in removing all the oil after a certain time in service and replacing it with a new batch, the used oil being passed through various types of purifying and filtering equipment, and then stored for future use.

Oil should be selected with careful regard to requirements and conditions of service. Viscosity should be referred not to the conventional standard of 100 deg. F. but to the actual temperature at which it will be used, as there is an appreciable variation in the viscosity of all oils, depending on their base and blending, with changes of temperature. The specific gravity of the oil, its emulsifying tendency when mixed with water, or frothing when churned with air—these actions varying with the temperature of the oil—and, also, to a certain extent, the flash point, are all factors that have an important bearing on the life and service qualities of the oil. They are items which should be regarded as of prime importance in the selection of the proper grade of oil in each case. The oil in service should be tested at frequent intervals because its viscosity and specific gravity and other physical qualities change very materially with use and age.

From available records of a number of companies, the operating temperatures of oil in the lubricating system of the larger size units vary considerably. The following tabulation, however, indicates the range of these temperatures on units of 20,000 kw. and larger, the apparent wide difference in values being due largely to the particular design of units:

Temperature of oil in degrees F.:

	Min.		Max.
At steam end of turbine	98	to	167
At exhaust end of turbine	101	to	155
At turbine end of generator	118	to	162
At extreme end of generator	118	to	165
Temperature of oil entering cooler	110	to	168
Temperature of oil leaving cooler	88	to	132
Temperature of oil in oil tank	110	to	140

While manufacturers can make an oil which will operate satisfactorily at 160 deg. F., it is recommended that under normal operating conditions 140 deg. F. be set as the maximum safe operating temperature, a still lower figure being desirable if this is practicable.

The proximity of the oil tank to the steam end of the turbine and its connection thereto are matters which require serious consideration. The oil tank and connections should be so designed as to prevent, as far as possible, the transmission of any heat from the turbine to the oil.

Purification of Oil

The purification of turbine oil is, in general, carried out by one of two methods—the continuous system and the batch system. In the first method the relief valve on the oil system of the turbine is made use of to bypass a portion of the oil continuously into a tank from which it is fed by gravity into the oil purifying equipment and then back into the turbine base. This acts as a loop in the oil system and keeps the oil constantly in good operating condition.

In the batch system the turbine base is completely drained at regular intervals into a reservoir or tank and a fresh supply of oil is replaced. The used oil is then purified and stored for future service.

In connection with the batch system, several makes of mechanical purifying apparatus working on the principle of a centrifugal separator are now being used with satisfactory results. One machine of this type is indicated in Figs. 1 and 2. Figure 2 shows a sectional view of the oil purifier bowl. The oil to be purified is fed into the top of the bowl and passes down the center to the bottom, whence it flows out and up through the holes in the discs, and is distributed in thin layers between the discs.

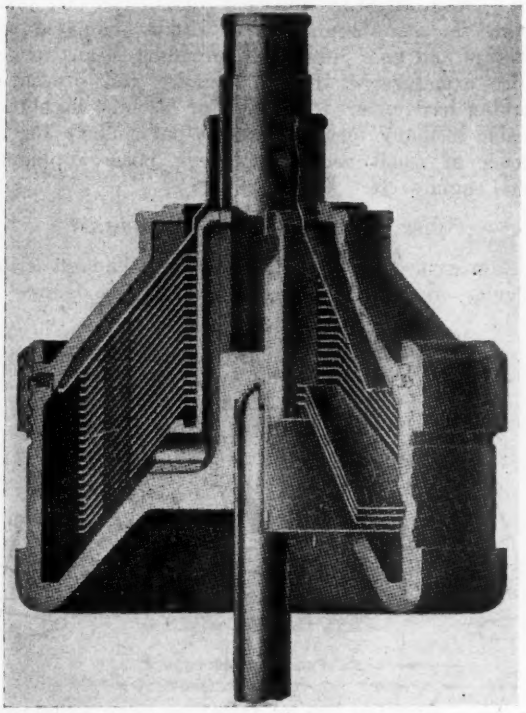


FIG. 2. SECTIONAL VIEW OF PURIFIER BOWL

Here, due to centrifugal action, separation takes place. The material which is heavier than water, such as sand and metallic particles, is thrown outward to the periphery of the bowl and held there in a sediment pocket by centrifugal force. The water, being heavier than oil, also passes outward and upward along the outer edge of the discs and from there to the discharge outlet.

The oil, being lighter, passes inward between the discs, where the thin layers are subjected to high centrifugal force, which throws out the remaining traces of impurities and water. These impurities are forced along the lower surface of each disc toward the sediment pocket, and the pure oil is forced toward the center shaft, and from there upward to the oil discharge outlet.

A recent test made on one of these machines with oil which had been used for turbine lubrication gave the following results:

Number of barrels treated, 5; number of gallons, approximately, 250; oil pre-heated to 120-140 deg. F.; time required to treat one barrel, 30 min.

Analysis of oil:

	Before filtering	After filtering
Water	53.45 per cent	0.011 per cent
Impurities	0.03 per cent	0.02 per cent

The performance of these machines in a number of recent installations shows results which are very satisfactory.

Oil Pressure

Another phase of turbine lubrication is the pressure at which oil is supplied to the bearings. With high pressures in use, it is necessary to have spare high-pressure pumping equipment available if the oil supply is cut off.

It is recommended that bearing oil pressures be kept low enough to permit lubrication by gravity feed from a tank located near the roof of the station building.

This plan appears to be more flexible than having a spare pump between the supply and the machine to maintain the proper bearing oil supply. If some gravity fed oil is kept flowing and the excess is permitted to run a filter, the life of the oil will be increased.

To Burn Pulverized Anthracite

RAPID progress is being made on the erection of the coal pulverizing plant at the Mt. Vernon St. Station of the Philadelphia Rapid Transit Co.

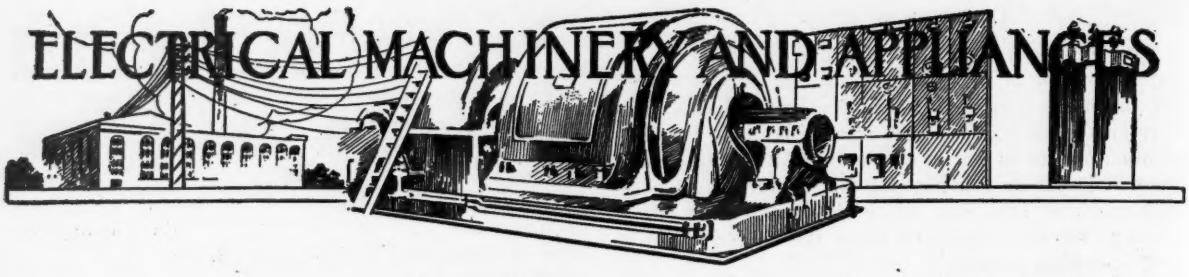
This plant, which is at present equipped with twenty 375-hp. water-tube boilers and has been producing about 75,000 kw.-hr. of electric energy, is being changed over to powdered coal firing, using river and buckwheat anthracite coal. It is estimated that the needed output of the plant will be obtained with but ten boilers, using powdered coal, as compared with the twenty formerly required for hand firing.

The fuel, after being dried and pulverized, is to be transported through 4-in. pipes to a sub-divided totally enclosed bunker, located between the banks of the boilers. From this bunker, it will be fed in controllable quantity into specially designed combustion chambers where the required air for combustion, also under close control, will be added.

In the coal milling plant a blow tank unit of five tons per charge capacity equipped with a quick reading scale is now in the course of erection. By compressed air, the fuel is delivered to the bunker and correct fuel records obtained for each boiler. Switching valves appropriately located along the fuel distribution line will deliver the coal to any desired section of the bunker.

Three thousand pounds of coal per hour is the capacity of the feeding and burning equipment of each boiler.

It is expected that the first of the boilers will be in operation during September.



A Study of Dynamo Electric Machinery---XVII

SINGLE-PHASE SERIES AND SYNCHRONOUS MOTORS. BY OTTOMAR H. HENSCHEL

ALTERNATING CURRENT motors may be classified as follows:

(a) Single-phase series motors.
(b) Synchronous motors.
(c) Polyphase induction motors.
(d) Single-phase induction motors.

From the discussion of direct-current machines, it was learned that the reversal of current flow through either armature or field windings would result in a reversal of direction of armature rotation, while a reversal of current flow through both armature and field windings has no effect upon the direction of rotation. Thus it is evident that an ordinary direct-current motor can be made to work on alternating current although practically operation is not satisfactory, this, however, due only primarily to the results of the inductive action of the windings. This is particularly well exemplified in the case of the shunt-wound direct-current motor. Because of the high inductance of the field winding, reversal of the applied electromotive force is followed by a gradual decay of the previously existing field current and a correspondingly slow growth of the reversed field current accompanied by a flow of current through the armature winding practically in phase with the applied electromotive force. As a consequence, a considerable phase difference exists between the current flowing through the field winding and that flowing through the armature winding and a negligible torque is developed.

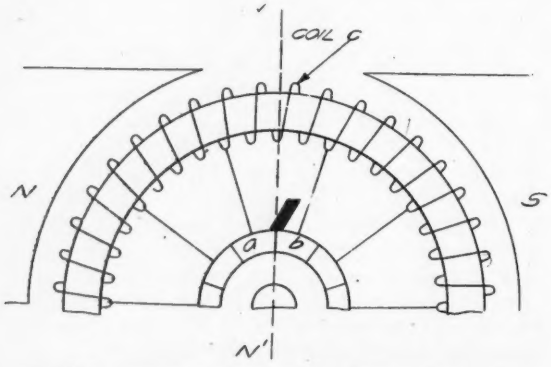


FIG. 120. SECTION OF TYPICAL RING-WOUND DIRECT-CURRENT ARMATURE

In the case of the series-wound motor, however, a somewhat different condition exists. Armature and field windings are connected in series, reversal of current flow occurs simultaneously, and as a result, no phase difference between armature and field current can take place. Fitting the series-wound motor with a laminated field structure and pole pieces and providing means to neutralize armature winding inductance and preventing sparking has rendered this type of machine highly applicable to many forms of service particularly for the driving of small vacuum cleaners, office appliances, dental engines, etc.

CAUSE OF SPARKING AND THE REMEDY

EXCESSIVE SPARKING at the brushes is the most serious difficulty encountered when attempting to operate an ordinary series-wound direct-current motor on alternating current. The cause of this is quite evident from a study of the action of these windings of this type of machine when carrying a current varying in value and alternately changing in direction.

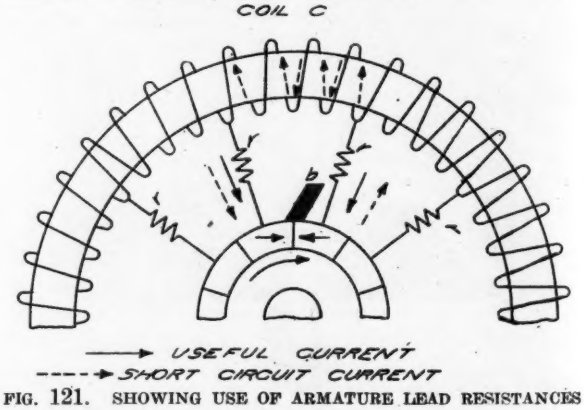


FIG. 121. SHOWING USE OF ARMATURE LEAD RESISTANCES

Figure 120 illustrates an elementary diagrammatic section of a typical ring-wound direct-current armature placed between the two pole pieces N and S. As coil C passes through neutral plane n, n' it is short-circuited through the brush and commutator segments a and b, this short-circuiting taking place, as explained in the discussions on the principles of operation of direct-current generators and motors, at the instant no magnetic lines of force are being cut, or in other words, at the time of minimum induced electromotive force. It is readily apparent, however, that when the fields are energized by alternating current, the resulting magnetization will also

be alternating in direction and variable in intensity; so that, instead of no electromotive force being induced in the short-circuited coil, this coil acts as a short-circuited secondary of a transformer carrying not only an induced electromotive force, but also a comparatively heavy induced current causing considerable sparking, destructive alike to brushes and commutator.

The value of the electromotive force, and consequently current flow through such a short-circuited coil is proportional to the number of turns of wire in the short-circuited section, the maximum value of the pulsating field flux and the frequency of pulsation of this flux. In order, therefore, to realize an appreciable reduction in sparking, each of these factors must be reduced to a minimum value; and it is therefore apparent that in the design of a series-wound alternating-current motor, a maximum number of armature winding sections (many commutator bars), minimum field flux per pole (many poles) and a comparatively low frequency such as 25 cycles per second be employed.

In addition, practice has indicated the need for other devices such as the insertion of resistances and balanced choke coils in each commutator lead. In Fig. 121 is shown a section of an armature winding, each commutator lead of which is fitted with a resistance. A study of this diagram readily reveals the part played by these resistances. Upon short-circuiting any particular coil such as C by brush b, the useful current is caused to pass through two of the resistance elements r and r connected in parallel, while the short-circuited current is also forced to pass through two of these elements but only when connected in series. Thus the short-circuited current is reduced to a minimum value.

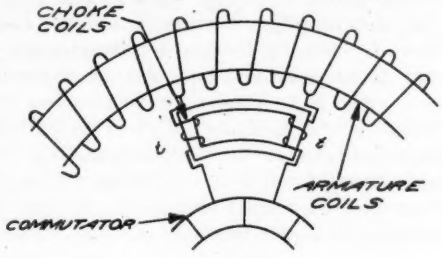


FIG. 122.

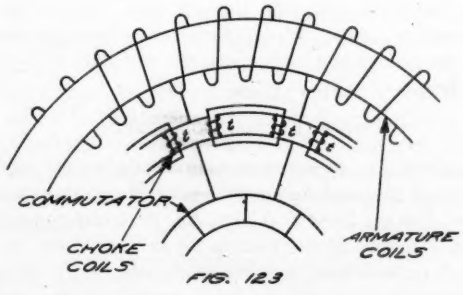


FIG. 123.

FIG. 122. SHOWING USE OF ARMATURE LEAD CHOKE COIL
FIG. 123. APPLICATION OF BALANCED CHOKE COILS

Use of these resistances is, however, not without its disadvantages. Considerable loss of power takes place and much difficulty is usually encountered in their proper embodiment within the structure of the armature.

The means by which the choke coil is employed to reduce sparking in a series-wound alternating-current motor is well shown in Fig. 122. Connected in series with each commutator lead is the winding of a choke coil, each of which is so wound and connected with reference to the other mounted upon the same laminated wire core that their magnetizing actions with equal flow of current into or out of the armature winding are equal and opposite in direction, thereby causing one to neutralize the inductive action of the other. As, however, a coil is short-circuited by a brush, the local current resulting of necessity flows through the two windings of the choke coil; but because of the scheme of connections employed, the inductive action of the coil is brought into play and the current flow "choked."

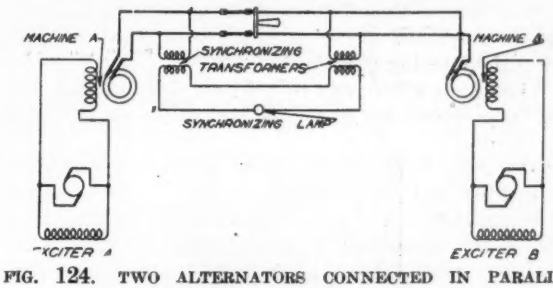


FIG. 124. TWO ALTERNATORS CONNECTED IN PARALLEL EITHER ONE OF WHICH MAY OPERATE AS A SYNCHRONOUS MOTOR

The manner in which these choke coils are actually employed is shown in Fig. 123. Each commutator lead is split into two branches and each branch contains a choke coil balanced against a similar coil in an adjacent lead.

Synchronous Motors

When operating two or more direct-current generators in parallel, the total load may be proportioned among the various units by the proper adjustment of the field rheostats of the respective machines, an increase of field resistance resulting in a decrease of load. With machines of the same capacity, the load is generally equally divided; while if machines of various ratings are employed, the load must be proportioned among the several machines in such a way that each carries its proper share.

Alternating-current generators operating in parallel cannot, however, have their loads adjusted in this manner. Proper division of load between these machines is controlled by their prime movers. This is sometimes accomplished by controlling all the engines from a common throttle valve, although the more usual scheme consists in running all the machines except one with their stop valves wide open and their governors fixed, so that the remaining engine may care for any variations in the common load.

Figure 124 is a conventional diagram representing two alternators connected for parallel operation. If, for some reason, the prime mover of machine B fails, not only will the load carried by this unit be thrown onto machine A, but machine B will become a motor and be driven by machine A, thus exemplifying an alternator driving a synchronous motor; hence, any machine usable as an alternating-current generator may be operated as a synchronous motor and vice versa.

Starting of Synchronous Motors

All single-phase synchronous motors require some external means of starting, such as a small steam or other engine, or a small alternating-current induction, or direct-current motor. These starting units may either be belted or geared to the synchronous motor, or, when a motor is used, this may be mounted directly on the shaft of the synchronous motor.

Polyphase motors can, however, very readily be started without any auxiliary starting motor. The application of the alternating current directly to the stationary armature without field excitation will result in a rotating magnetic field about the armature core. The eddy currents thereby produced in the pole piece will exert a torque on the armature and cause it to speed up to synchronism. Usually some form of starting compensator is employed for reducing the applied voltage during the starting period.

When up to speed, and its field normally excited, the motor is synchronized and connected to the supply lines

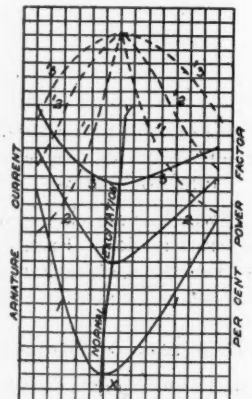


FIG. 125. PHASE CHARACTERISTIC OR V CURVE OF SYNCHRONOUS MOTOR

in exactly the same manner that an alternating-current generator is synchronized and placed in parallel operation with one already running.

Speed

Synchronous motors are practically constant speed machines. When overloaded, shunt-wound direct-current, and alternating-current induction motors will gradually slow down until stalled. Such is not the case with synchronous motors. The per cent of overload any such motor will carry is fixed for each individual machine, and any increase of load above the specified maximum figure will cause the motor to "fall out of step," that is, out of phase relation with the supply voltage, and stop, after which the load must be disconnected and the motor again brought up to proper speed, synchronized and thrown onto the supply lines.

Synchronous motors are so called because they operate in synchronism with their driving generators, so that under all conditions of operation, the speed of such a motor bears a definite relation to the speed of the driving generator.

Alternating-current generators and synchronous motors being interchangeable, the speed of the latter may, therefore, be calculated in the same manner as that of the former.

Excitation

This, as in the case of alternators, may be supplied by a common exciter used in connection with a number of synchronous motors or alternators or may, as is usually done, be supplied by a separate machine, the armature of which may be mounted on an extension of the motor shaft. Each machine requires, at no load, a definite exciting current under which conditions a minimum number of amperes will be drawn from the line. We find, however, by plotting the number of amperes of line current against the corresponding number of amperes of exciting current, that with any deviation from the normal exciting current an increase of line current will result. If various values of exciting current and corresponding values of line current readings be plotted against each other, a V shaped curve as shown at 1 in Fig 125 and known as the phase characteristic will be obtained. Repeating this plotting of readings for half and full load, we get curves 2 and 3, Fig. 125.

From this it would appear as if an increase or decrease of field excitation from normal would result in a greater consumption of energy without any additional load on the motor. This, however, is not the case. If at the time of obtaining the phase characteristic readings, power factor readings had also been taken and plotted, we would have obtained curves such as shown by the dotted curves '1, '2, and '3, thus indicating that even though the line current becomes excessive, the actual energy consumption is but little more at extremes of excitation than at normal excitation. At high values of line current, the power factor is necessarily extremely low.

Another interesting point which the use of a power factor meter will bring to light is that, with an exciting current below normal, the line current lags behind the electromotive force, while with an exciting current greater than normal the line current will lead the electromotive force.

Power Factor Correction

To secure the greatest economy both in first cost and operation of alternating-current machinery, transmission and distribution lines and so forth, it is imperative that the power factor of the system be as near unity as possible. This, however, is a condition not easily obtained, as the greater share of the load carried by the average station is of an inductive nature, such as transformers and induction motors, resulting in a low, lagging power factor.

The current taken by a synchronous motor will lead the electromotive force when the exciting current of the motor is greater than normal or, as technically stated, "an over excited synchronous motor will draw a leading current," thus enabling it to neutralize wholly or in part the lagging effect of an inductive load.

Hunting

One of the greatest difficulties encountered in the operation of synchronous motors, especially if these be supplied with current generated by machines driven by reciprocating engines is the tendency to "hunt," result-

ing in a considerable voltage disturbance over the entire system. This phenomena is similar to the behavior of a steam engine under the control of an oversensitive governor.

With a sudden increase of load, the speed of a synchronous motor momentarily slows down and falls behind the generator in phase; and when the speed has dropped sufficiently to allow the machine to take in the power required to operate it, it is still running somewhat below synchronism. Further reduction in speed takes place and as a result an excess of power is taken from the supply line which causes a decided increase in speed above synchronism. It then gains on the generator in phase until the intake of power is less than that required when the speed of the motor again drops and the cycle is repeated. This oscillation of speed above and below synchronism is termed "hunting" and is accompanied by a varying current consumption and by a rapid rise and fall of electromotive force between the motor terminals.

Hunting may frequently be traced to the periodic changes in driving engine speed. Thus the engine momentarily increases in speed as the steam acts upon its piston and diminishes its speed during the intervals between strikes. This cause of hunting may, however, be readily eliminated by the employment of turbine-driven generators.

Hunting may be entirely eliminated or at least greatly reduced by the use of a loose flywheel on the motor shaft or by the employment of "dampers," which consist of rectangular copper frames driven into place under the overhanging tips of two adjacent poles. Such a damper is provided between each pair of adjacent poles, all around the field, both in the alternator and in the synchronous motor.

Another form of damper found quite effective is the squirrel-cage damper. Heavy bars of copper are placed in slots at the surface of the poles and their ends bolted to two closed copper rings, so as to short-circuit all the bars.

The principle of the damping action is that the shifting magnetic field sets up an induced current in the short-circuited frames or bars of the dampers, and these currents react on the magnetic field so as to oppose the shifting of the flux and thereby dampen the hunting oscillations.

Use of Synchronous Motors

Synchronous motors are applicable only where no high starting torque is necessary, where frequent starting and stopping is not required, and where constant speed is desired. Their field of usefulness is, therefore, somewhat limited. Due to the effect which a variation of its field excitation has upon its power factor, the synchronous motor is extensively used for the purpose of correcting a low, lagging power factor, such as is caused by heavy transformer and induction motor loads. Many central stations supplying both alternating and direct current generate the former only, and obtain their supply of direct current either from direct-current generators driven by synchronous motors, or from synchronous converters. Under proper conditions of operation, the field excitation of these synchronous machines is maintained at its normal value, but with a heavy inductive load on the system, creating a low, lagging power factor, overexciting the fields of the synchronous machines will cause the motor to draw a leading current, and thereby improve the power factor.

When there is no use for the mechanical power in the generating station, synchronous motors are frequently connected to the distribution system at some distant point and allowed to float on the line with an overexcited field, for the express purpose of correcting a poor power factor; and in order to prevent the idle operation of such machines, the managements of central stations many times offer special inducements in the form of lower rates to power consumers who will use synchronous motors instead of induction motors.

When used for the express purpose of power factor correction, synchronous motors are generally termed synchronous condensers.

Balancing Action

The fact that a synchronous motor draws a leading current when overexcited and that the value of this leading current is increased with an increase of overexcita-

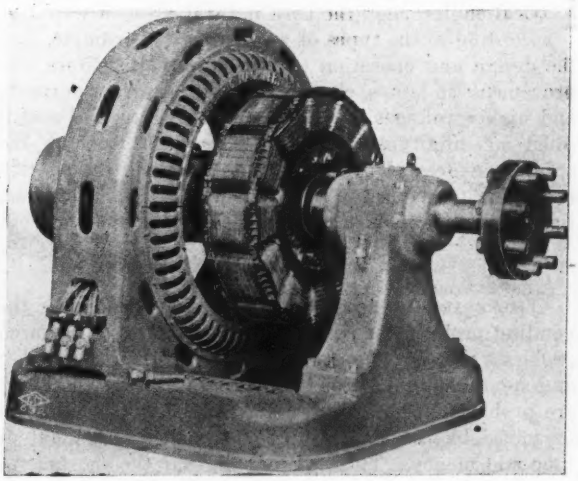


FIG. 126. TYPICAL 200-HP. SYNCHRONOUS MOTOR WITH ROTOR SHIFTED OUT OF FRAME

tion, gives to this type of polyphase machine the capability of restoring a balance to an unbalanced polyphase circuit. When a slightly overexcited motor is connected to the terminals of a balanced or an unbalanced polyphase system, all phases of the motor armature draw a leading current. That phase winding, however, which is connected across the terminals of lower voltage, draws a greater leading current than the other windings, because its overexcitation is relatively higher, hence the compounding tendency of the leading current is more marked in this phase than in the others, and the voltage thereof is increased. This action tends to balance the circuit, not only in voltage but in current as well, because combinations of leading and lagging currents give reduced resultant currents.

Advantages and Disadvantages

The synchronous motor, especially in large units, possesses a number of features which make its use at times preferable to that of the induction motor. These

may be briefly summed up as follows: (a) Unvarying speed at all loads; (b) Power factor variation at will by change of exciting current; (c) The current in the armature can be made to lead the electromotive force by over-exciting the field magnets, thus producing the same effect as a large condenser. The leading current in the armature can be used to neutralize the unfavorable effects of inductance in other parts of the system; (d) The synchronous motor is cheaper to build, especially for low speeds, than the induction motor; (e) Its efficiency is generally higher than that of the induction motor; (f) It is specially adapted to high voltage winding.

This type of motor has on the other hand, the following disadvantages: (a) It is not adapted to work requiring variable speed; (b) It has small starting torque, hence is not suitable for work where the load at starting is large; or frequent starting is required; (c) It has a tendency to "hunt"; (d) It requires an exciting current which must be supplied by an outside source; (e) It requires skillful and intelligent attention.

Questions and Problems for Review

How may alternating-current motors be classified?

2. What prevents the use of the ordinary direct-current motor on an alternating-current source of supply? How is the difficulty overcome?

3. What is a synchronous motor and how does it operate?

4. How is the synchronous motor employed for power-factor correction purposes?

5. Enumerate the various advantages and disadvantages of the synchronous motor.

Some Present Day Research Problems in Electrical Engineering*

By Vladimir Karapetoff

IN THE investigation of unsolved problems in electrical engineering, the most natural division would be according to the types of apparatus, for example, into the design and operation of large turbo-alternators, improvements in lamps, circuit breakers for larger currents and higher voltages, etc. Such problems may be multiplied ad infinitum and one has only to refer to the opinions expressed by competent men as to the specific needs for theoretical or experimental research in practically every branch of the electrical industry.

Caliber of Investigator

There are, however, other means of classifying the pending problems of research. One division of research problems that is quite essential is based upon the caliber and mental equipment of the investigator himself. There are problems of great importance which can be and will be solved by the expenditure of a sufficient amount of time and money. Thus, during the war the shortage of certain materials led to a large number of tests on substitutes, and in some cases satisfactory materials were found by men of average ability and education.

At the other end of the scale, we have researches which require men of exceptional intellectual power and of wide erudition, researches which have baffled the most persistent efforts of many years and problems which remain unanswered in spite of the most alluring financial inducements. A reliable high-tension insulator and a simple variable speed alternating-current motor may be mentioned as two such examples. The tendency is to lay too much stress on material resources, equipment, and other external factors. A few men of superior caliber and thoroughly trained will accomplish results on which thousands of less gifted and not so thoroughly trained investigators may work for many years without much progress.

The necessity for better care of persons of exceptional scientific intellect is urgent; but unfortunately in this imperfect world of ours it is nobody's particular business to attend to the proper development of geniuses.

A solution to this problem would be a system of detecting exceptional children by suitable mental tests and then guiding them year after year to the full development of their mental powers. This is a proper function of the state and some day will become a reality.

Pure and Applied Research

Another classification of research problems is in accordance with their proximity to or remoteness from the direct industrial applications. A certain physical phenomenon, a mathematical formula, a peculiar alloy, etc., may up to a certain time possess no practical importance and be merely a subject of personal interest to a few investigators. Then one day somebody discovers that that particular alloy or formula offers great practical possibilities and it becomes the subject of extensive industrial researches.

The electrical industry owes many of its triumphs to so-called pure physical research, but until recently this industry offered mighty little encouragement to such research or to its exponents. Had the leaders of the electrical industry realized earlier the tremendous possibilities of physical research in improving commercial apparatus, then instead of sneering at "doctors" they would have used their talent long ago, and we should have been much farther advanced in the applications of electricity than we are now.

Thus the promotion of pure research is another national problem and the first aim must be the training in the methods of analysis, general laboratory methods, the ability to find what is already known, the use of mathematics, the use of methods borrowed from other branches of science, general accuracy of measurements, of computations, of statements, and last though not least, that loving attitude towards nature and the intuition that comes only from a first-hand contact and observation of actual physical phenomena without any preconceived theory or utilitarian thought.

Experimental and Theoretical Research

The next division of research problems is into experimental, mathematical, inventive, critical, indicative of new fields, etc. A clear understanding of this division

*Abstract of an address delivered by Prof. Karapetoff before the Erie Section of the American Institute of Electrical Engineers.

on the part of investigators themselves and of their business managers is essential.

Almost any big research problem involves some theoretical study as well as experimental skill, inventive ability, and patient search for the work of other investigators and its critical analysis. Only a very few investigators possess all these accomplishments to the same degree, and it is in the hands of a harmoniously organized group of scientific workers of different talents that research leads to gratifying results.

A chain is strong only as its weakest link. Many a research worker struggled in vain with a problem for which he was eminently fitted, just because he failed to recognize this one weak link in himself or was too proud to ask for help on some particular point of difficulty.

The investigator ought to know how to let go of his idea and allow his assistants to play with it for a while and see how it shapes itself in detail. If in the preliminary molding of his ideas he should be handicapped by his lack of mathematical ability or of foreign languages (two handicaps common in this country) let him not try to solve the problem in an imperfect manner alone without first having exhausted the possibilities of associating with other gifted and congenial minds who may furnish the missing needs of the problem. One man is especially gifted in arranging ingenious methods for accurately measuring difficult quantities; another can skilfully present a phenomenon or a relationship in a mathematical form; a third is particularly adept in finding out quickly and accurately all the preceding contributions on the subject and in assigning the proper relative value or trustworthiness to each.

The possibilities of co-operation in research on the part of persons of different temperament and ability go far beyond the confines of one industrial organization or even one country. International co-operation in research is just as important in view of the favorable and unfavorable racial idiosyncrasies. Anybody who follows European scientific magazines cannot fail to notice these racial distinctions in the treatment of identical subjects.

In conclusion, I wish to point out that while first-class original investigators are born and not made, yet there is a great problem before our leaders in politics, industry, and education, to facilitate the work of such men by granting favorable conditions for their creative activity. We ought to do this for our sake and for that of the coming generations. It is in the hope of contributing to the clear understanding of the conditions that promote the welfare of research workers that the preceding remarks are made.

Protection of Life Against Fire

PREPARED BY THE ENGINEERING DEPARTMENT OF THE NATIONAL SAFETY COUNCIL

PROTECTION of human life from fire has often been overlooked or given only secondary consideration by building designers and owners; however, during the last 10 yr. several serious fires, involving heavy loss of life, have attracted general attention, so that today more thought is being given to this subject.

While all states and many cities have fire escape laws or ordinances, many of these are quite out-of-date. In only a few states can the employer feel assured that, by complying with legal requirements, he has actually given his workers a fair chance to escape in case of fire. Whether required by law or not, every factory or other workplace should have at least two exits from each story, of sufficient size for the number of persons accommodated, so designed and constructed that the occupants can and will use them if a fire occurs.

Those forms of exits are best which protect property as well as life, and which increase, rather than decrease, the convenience of the building for ordinary use. No exit, however, is efficient unless it is always ready for immediate use, and unless, when used, it will lead the occupants to safety.

Various forms of exits are:

(a) Horizontal exit—a door through a fire wall, or an outside balcony or bridge leading to another building or division.

(b) Exterior enclosed stairs—cut off from the building, and reached by balconies or vestibules.

(c) Interior enclosed stairs—fire-resisting enclosure with fire doors.

(d) Interior stairs—not enclosed.

(e) Elevator.

(f) Outside stairs—not enclosed.

(g) Outside fire escape, stairway type.

(h) Outside ladder.

(i) Special forms of fire escapes, such as chutes, poles, and ropes.

The horizontal exit is believed by most fire protectionists to be the best for the protection of life, especially where there are a large number of persons on one floor. The occupants, after passing through a fire door or across a bridge, are in a protected area from which they may descend in safety without excessive haste.

Adequate stairways must, however, be provided for moving the occupants to the ground level as soon as they have passed through the horizontal exit, because there is a possibility of the fire spreading to a floor beneath them, and because the fear of fire may result in panic.

The exterior enclosed stairway, or "smoke-proof tower," completely separated from the building by a fire wall, is the safest medium for moving people downward, because it cannot be seriously obstructed by smoke from a fire on a lower floor. As such stairways must be reached from each floor by means of an outside balcony, they are generally not suitable for everyday use. They are desirable as emergency exits in high buildings, especially where there is inflammable material. Some laws require this type of stairway under certain conditions.

The interior enclosed stairway, commonly found in modern buildings, is surrounded by fire-resisting walls or partitions, the entrance at each floor being protected by a fire door. Such stairways are efficient both as fire exits and for everyday use. They are not quite so safe, in case of fire, as an outside enclosed stairway, because they may be obstructed by smoke if a door is left open.

Open stairways and elevator shafts cannot be de-

pended upon as fire exits. They act as flues and quickly spread the fire from one floor to the next. In new buildings of more than two or three stories open stairs should not be permitted. In existing buildings it is advisable, especially if there are a considerable number of occupants, to enclose the stairways with fire-resisting partitions. Such enclosures not only safeguard the occupants, but also protect the building and its occupants by preventing the rapid spread of fire from one floor to another. In the case of single-run stairs, the enclosure should include a passageway on each floor, from the foot of one stair to the top of the next stair, so persons may go from the upper floors to the street without leaving the enclosure.

Fire Protection an Individual Problem

Compliance with the law does not always provide the utmost protection to the workers in a factory building, as many of the states and cities of the country do not have adequate fire prevention laws, and in some cases there are no regulations whatsoever. Furthermore, each factory is an individual problem in itself and requires treatment as such. The law, however well made, cannot contemplate many of the small points which present themselves at times, and it is, therefore, up to the factory executive to survey his plant thoroughly, with a view to eliminating all danger in case of fire. As this article shows, a properly designed fire escape may be made useful at other times than during emergencies, and in the latter event, may be a protector of property, as well as life. It is the older buildings that present the most difficult problems, as they are frequently fire traps in themselves and require the most efficient and convenient fire escapes available.

A thoroughly efficient fire alarm system is an added protection, as it gives notice to those on the upper floors in case of fire in any part of the building and permits them to escape before the fire has trapped them.

Outside open stairways, for general use, are often seen on two or three-story factories. These are better exits, in case of fire, than the ordinary fire escape, because the occupants are accustomed to using them. Each outside stairway should, if possible, be covered by a roof to keep off snow and rain. Wooden stairways are not recommended; they require frequent inspection, and repair or replacement when they begin to rot.

The so-called stairway-type fire escape is simply an outside stairway for emergency use. Many fire escapes built only "to comply with the law" show several or all of the following defects: Flimsy construction, excessive openings between platform bars, inaccessibility from workrooms or public passageways, lack of fireproof windows to protect against fire in lower stories, lack of extension to street level, use on high buildings where height causes panic, unsafe condition caused by lack of maintenance, snow and ice, other obstructions. Fire escapes are also open to the following general objections, as compared with enclosed stairways: They furnish no protection to property; they add nothing to the convenience of the building for daily use; and, being never used except in emergency, when emergency and panic come the occupants often forget or do not know how to use them.

It is nevertheless true that a stairway fire escape—preferably called an outside stairway—if properly designed, located, constructed, and protected, is a safe, efficient exit.

Number and Character of Exits

The National Fire Protection Association recommends as follows: Two means of exit remote from each other must be provided from every building or section. Above the second floor, one of these must be an inside stairway or a smoke-proof tower, and the other may be an inside stairway or a smoke-proof tower or a horizontal exit or an outside stairway, except that where a building or section has horizontal exits to two or more buildings or sections, in or through each of which access may be had to an inside stairway or a smoke-proof tower, no inside stair, smoke-proof tower, or outside stairway need be provided.

Exits shall be so arranged with regard to floors that there are no pockets or dead ends of appreciable size in which persons might be trapped.

Doors giving access to means of egress must swing with the travel or slide across the travel, and there should be no obstructions to stairs or on stairs or on landings; provided, also that swinging doors during their swing shall preferably not reduce the effective width of the stairs or landings, and that swinging doors when open shall not interfere with the full use of stairs.

The distance from any point where a person may work to the nearest available exit shall not exceed:

(a) High hazard occupancy..... 75 ft.
(inflammable material)
(b) Moderate hazard occupancy..... 100 ft.
(moderately combustible)
(c) Low hazard occupancy..... 150 ft.
(practically incombustible)

The number of persons in any building, or on any floor should not be greater than the number which can leave the building safely in case of fire. The number of persons who can safely occupy a building depends upon the aggregate width of exits.

Exit Signs and Lights

Exit signs should be freely used to guide persons toward safe exits, especially those of emergency character. When used at night, such signs should be illuminated or a light should be placed over each sign. Such lights should preferably be on a separate circuit. One member reports the use of illuminated arrows, pointing toward the exit, connected with the fire alarm circuit.

Red signs and lights have commonly been used to indicate exits. Some safety engineers, however, now suggest that, as these signs and lights lead to safety and not to danger, green should be used. A white sign on a green background is better than green on white.

Maintenance

It is essential to keep all exits free from obstructions and ready for use at all times. Passageways of ample width should always be maintained, leading to emergency as well as to regular exits; white lines, painted on the floor, may be used to indicate passageways. The windows and doors leading to emergency exits should be frequently inspected and tested to make sure that they will open easily. "Panic bolts," which

open by simply pressing against a bar or plate, are recommended for exit doors used by a considerable number of persons.

Lives have been lost by fire even in buildings fairly well equipped with exits, because the occupants on upper floors did not know of the fire until it was too late to get out. To prevent this, a reliable alarm system is necessary. The best is a system of electric or electromechanical bells or horns, on a closed circuit, or combination open and closed circuits. These bells or horns should be sufficient, in number and size, to be heard throughout the building above the noise of machinery. They should indicate, by the number of strokes or blasts, the station or floor from which the alarm was turned in.

Open circuit alarm systems are frequently found, and some of them have doubtless helped to save lives from fire. Such systems cannot be recommended for general use, because if the battery or other source of electric energy fails, or if the circuit is broken, no warning is given. If a fire should then occur, the system would be inoperative when most needed. When an open circuit system has been installed it is essential to test it at least once each day, and to watch carefully the batteries and connections.

Mechanical gongs, operated by pulling a wire or chain, are sometimes used in small factories where the hazard does not seem to justify the cost of a high-grade electric system. Such gongs must be placed in a vertical line, one on each floor, all operated simultaneously by pulling a wire which runs through all floors. The wire should be enclosed in a pipe, or otherwise guarded, so it will not become blocked, broken, or bent. Alarms of this type also require frequent inspection to make sure that they are in good order. Such alarms, however, are not generally recommended; some states prohibit them.

It is not generally considered advisable to use the same bells for fire alarm and general call purposes. The alarm system should, however, be used whenever a drill is held.

In very noisy or hazardous plants, automatic circuit breakers and engine stops are often connected with the alarm system, to shut down some or all of the machinery when an alarm is given. The lighting circuit, and the operation of elevators and fire pumps, should, of course, not be interrupted. If the engine is shut down while the machines are running, care must be taken to disconnect each machine before starting the engine again.

A fire alarm system is valuable, not only for getting people out of the building, but also for summoning the private fire fighting brigade.

An Improved Form of Weir for Gaging in Open Channels*

An Account of an Entirely New Weir Tested at The Massachusetts Institute of Technology. By Clemens Herschel

IN 1917, the American Society of Mechanical Engineers appointed a committee to draft a revised form of Power Test Code, and invited three other Founder Societies to appoint advisory committees to the same end. Very soon afterward, it appeared that the subject of weir measurements and of their accuracy was in a most deplorable state of confusion. On the proper representations having been made to Engineering Foundation that a new set of experiments on weir discharge were liable to lead to a considerable advance in knowledge in this branch of applied science, it made an appropriation for that purpose. This appropriation was expended by the author in conducting the experiments which resulted in his devising an entirely new weir.

This weir bears no resemblance to the sharp-edged weir now in use. Its discharge is represented by a straight-line formula from 0 up to 9.55 cu. ft. per sec. per ft. in length of weir and thus continuing presumably indefinitely beyond that quantity. Its equation is $Q=5.50\,d$; d being the difference of two observations of water height or pressure; the one taken just upstream from the weir, and the other at the crest. In both cases d is obtained by measuring the elevation of a water surface in a pail by means of a hook gage, or otherwise as desired. This difference of pressures may also be obtained by means of one of the many apparatus already invented and on the market for measuring differences of pressure, in which case the register may indicate mechanically the quantity passing at any moment, sum it up for any given period of time, record it graphically on a chart, or do all of these recording operations simultaneously.

R. E. Horton, in discussing Francis' formula for the discharge over weirs, states, "If Francis had used higher and lower heads, he would have discovered that no one equation of the form he uses, $Q=mh^n$, can fit accurately to a series of experiments on weirs."

It is very likely that Francis saw this, for Francis was very particular to state that the formula he gives must be used only between stated limits of head and only upon fulfillment of other stated conditions of weir construction and operation.

It will be observed that Horton's criticism of Francis' formula is not applicable in the case of the new weir herein described. The process described does fit accurately a series of experiments on weirs. And it does so, with the added simplicity of making the exponent n equal to 1.

The reason that it accomplishes all this is because it is carried out with a weir that is not a "sharp-edged weir," the type that has rested like an incubus of an evil spirit upon the minds of all hydraulicians for full 200 yr.

The New Weir

The fundamental idea followed in the design of the new weir (Fig. 1) was to have the water to be measured conducted over the weir in a gentle manner, and so as to have it flow smoothly and regularly from the time it first encounters the weir construction, until it leaves it. Instead of allowing the body of water to impinge with more or less violence, according to the velocity with

*Abstract of a paper presented at the spring meeting of the American Society of Mechanical Engineers.

which it approaches the weir, against a perpendicular wall in its path (the upstream face of the ordinary weir) it is gently led to the crest by a 2:1 slope. Instead of striking or being torn over a sharp edge at the crest, the crest is made in the form of the arc of a circle; and instead of bothering about air under the nappe, the nappe is supported on another 2:1 slope downstream from the crest. Moreover, the crest is made hollow, so that observations of the pressure, or lack of full pressure, whichever the water may elect to exercise, can be taken at the crest, not at a distance upstream from the crest varying according to the fancy of the experimenter.

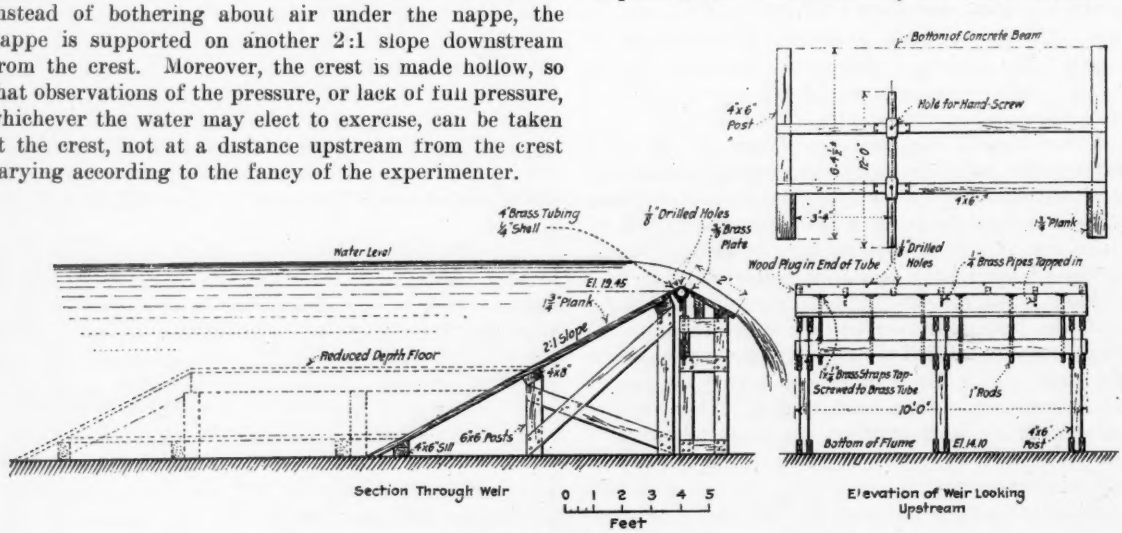


FIG. 1. THE NEW WEIR

In the experiments, the difference of water elevations or pressures, the one taken upstream from the weir and the other taken by means of the hollow weir test, proved to be a function of the quantity of water passing over the weir.

The orifice in the side of the concrete flume conducting water to the hook-gage pail for measuring water

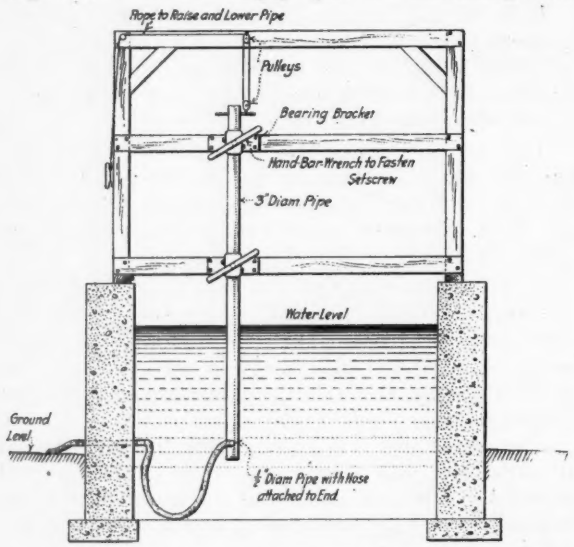


FIG. 2. APPARATUS TO OBSERVE WATER ELEVATION UPSTREAM FROM THE WEIR

elevations upstream from the weir was made flush with the flume side, at a point 13.9 ft. upstream from the weir crest center, and 1.68 ft. below it in elevation.

Furthermore, to connect the water passing over the weir with the hollow of the weir crest, a series of ⅛-in. holes were carefully bored through into the latter. This was done by first tapping in a solid brass plug, and then boring a hole ⅛ in. in diameter through this plug. A natural inclination would be to bore these holes at right angles to the surface of the water; but as this varies with the quantity passing the weir, such an inclination is impracticable. There are only two other natural directions for such piezometer holes,—either vertical, or at right angles to the upstream slope of the weir; and if the latter, naturally at the line of tangency of that upstream slope and the arc of the weir crest. The vertical holes are called "Orifices No. 1" and those perpendicular to the 2:1 slope "Orifices No. 2."

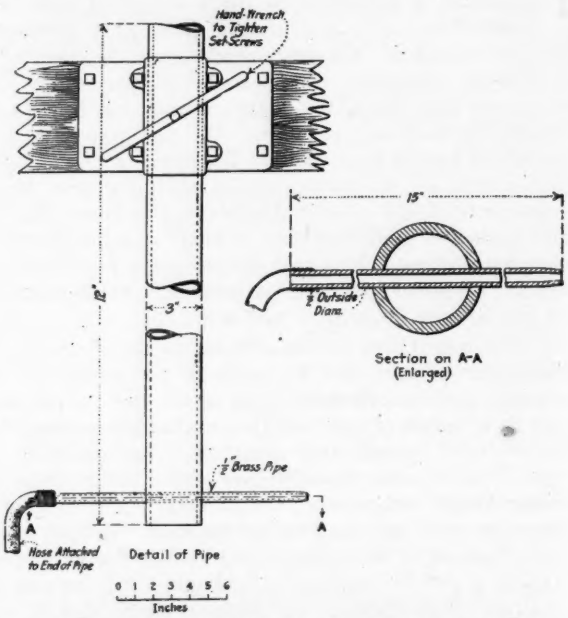


FIG. 3. DETAILS OF APPARATUS SHOWN IN FIG. 2

Both kinds of piezometric orifices were tried, and the last named proved much the superior for general use.

To vary the velocity of approach, a false bottom was put into the channel for some of the experiments.

The diagrammatic drawing, Fig. 1, will make clear the description of the weir test apparatus just given .

To increase the quantity per foot in length of weir, the available capacity of the pump was in many of the experiments made to pass over only about 3.3 ft. of the length of weir, while other series of the experiments used a weir about 10 ft. long.

Automatic Correction for Velocity of Approach

Figures 2 and 3 show the apparatus which was intended as a means of observing the water elevation upstream from any part of the weir automatically corrected for velocity of approach by taking in the water pressure through a pitot orifice pointing upstream and transmitting it to a hook-gage pail in the usual manner from out of the downstream side of the vertical tube.

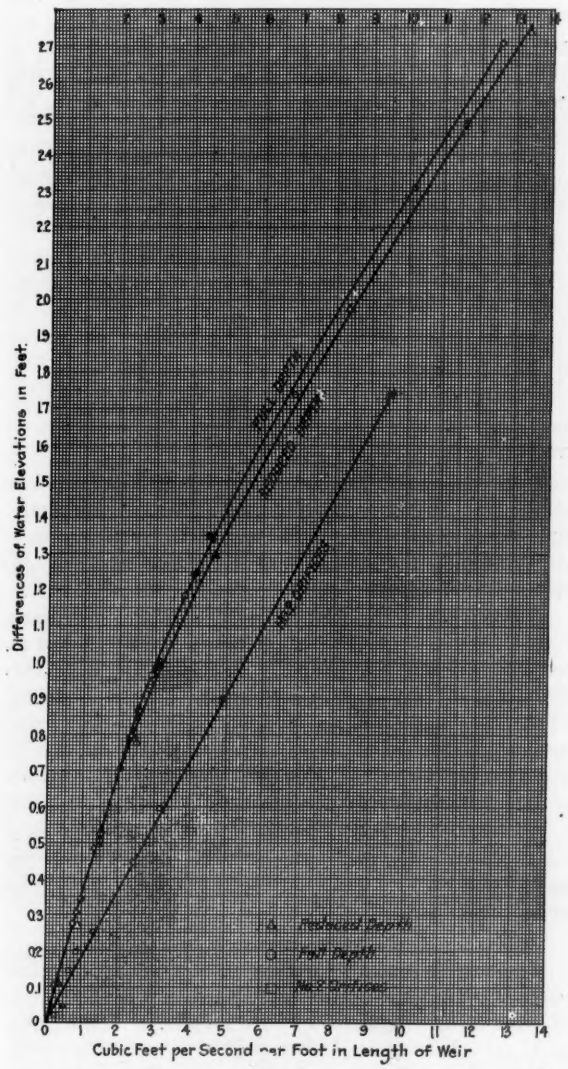

Differences of Water Elevations in Feet
Cubic Feet per Second per Foot in Length of Weir
Reduced Depth
Full Depth
Net Difference

FIG. 4. DIAGRAM SHOWING THE RESULTS OF THE 40 EXPERIMENTS MADE

The tube is held in its guides by two clamp screws, and may readily be set so as to bring the pitot orifice in the locus of mean velocity as it may be judged or found. In the experiments it was set at 0.6 depth of water, and ⅓ the width of the channel from either side. A scale of feet and tenths on the tube, reading up from zero at the pitot orifice and aided by another scale or gage painted on the side of the concrete flume, reading up from zero at the flume bottom, readily permitted this.

The Experiments

The experiments were conducted at the Hydraulic Laboratory of the Massachusetts Institute of Technology. A crew of six men, including three observers, with a captain worked with the apparatus from Sept. 10 to Oct. 3, 1919. The results of the 40 experiments are shown by the curve in Fig. 4. It shows that the No. 2 orifices act according to the straight-line equation—

$$Q = 5.50\,d \text{ in English units}$$
$$Q = 1.07\,d \text{ in metric units.}$$

All that is necessary is to measure the length of the weir and multiply by 5.5 and the difference in head.

In Search of the "Vackume"

Jabe Hoskins Relates His Experience Before the Pucketville Engineers' Club. By I. B. Leavitt

THE Pucketville Engineers' Club met, as usual, in Barber's warehouse, on Saturday night. It had been announced at the previous meeting, that on this night Jabe Hoskins, engineer at the sawmill of Henderson Hillyer, would tell all about his search for the vacuum in the feed pump and water heater.

After some shuffling of boxes and crates, on which the members were seated, and several fresh chews of tobacco taken, the president, Aleck Haines, said, "Now, Jabe, tell us your troubles 'bout the vackume."

Jabe untangled his long legs from the crate he was sitting on and arose, addressing the members as follows:

"Feller members of this injine driver's club, I don't know whether you ever had trouble with a vackume or not, but she shore is some pest.

" 'Long 'bout a month 'go, we hed trouble with our boiler and water heater, an' the ole feed pump 'ud git to running' abaout like a mustang pony that was never broke to bridle an' bit. Sometimes she 'ud travel along even like an' pump water into the boiler all right; then next thing you knowed, she'd be cuttin' capers to beat the band.

"She'd be slam-bangin' an' a poundin' the ends as though she just couldn't hold herself in any more, an' mind you, fellers, she wouldn't be a-pumpin' any water when she acted up that-a-way.

"The way that pump acted just 'minded me of tryin' to plane a board with a big knot in it; she'd stick, then she'd slip an' go like greased lightnin', an' then stick ag'in an' do the same darn' thing over ag'in.

"Well, she sure hed me guessin' some; I oiled her a-plenty, an' then I screwed up on the packin' box, but it wasn't any better.

"On Sunday I went out an' opened up the pump, ez I thought mebbe a couple o' eels hed got into 'er, an' was makin' her slippery, fer eels, you know, are awful slippery animiles.

"Well, there jest wasn't nothin' in the pump, so I shet her up ag'in. But, bust my galluses, ef she didn't do the same thing the next week, an' sometimes I couldn't get water 'nough in the boiler.

"Well, she jest 'baout hed me petered out, when

Hend. Hillyer, the boss, sed he'd write to that boiler inspector feller; he sed he was down to Clarksburg, an' he could likely 'nough tell us what was wrong.

"So he writ to the inspector feller, an' next week follerin' we got a pust card from him sayin', 'You got a vackume in your heater; put a light check valve on, like sketch.'

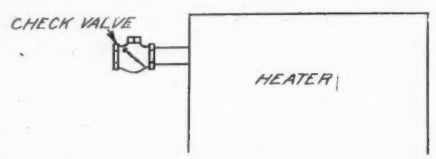
"On the card he hed drawed a pitcher of a valve on the heater, like this. (Jabe drew a crude sketch on the small blackboard on the wall). He sed this'd destroy the vackume.

"Well, I tol' Henderson Hillyer, the boss, thet he jes' needn't git no check valve, an' that if there was anything in thet heater Jason Hoskins, the injine driver, w'u'd git it out, an' make short work of it.

"Well, bust yer galluses, ef I didn't go over to the mill after supper that night, 'n' I ripped the dinged heater open.

"I wuz madder'n a wet hen, an' I decided thet, ef there was a vackume in thet heater, dead or 'live, I wuz a-goin' to hev' it out o' there an' show it to the boss in the mornin'.

"Well, I looked in; no vackume in sight; nothin' strange in there but some mud an' leaves. Next, I tuk out them porus plates the water runs over, an' held the lantern in the heater. No darn' vackume c'u'd I see. Put my head way down in the heater to look 'raound, an' jes' then the box I wuz standin' on slipped out an' slid from under my feet, so thet the upper half of



THE BOILER INSPECTOR SUGGESTED THE USE OF THE CHECK VALVE IN THIS MANNER

my carcass wuz hangin' inside, an' the other half hangin' outside the water heater, with the sharp edge of the plate a-cuttin' me in two in the middle.

"There wuz no use hollerin' with my head in the heater, fer nobody wuz near enough to hear me.

"I was squirmin' an' scratchin' like a pair o' tom cats with their tails tied together an' hung one on each side of a fence.

"Well, after clawin' in the mud a-while, I got holt o' sumthin' an' managed to back out o' the heater, feelin' like a sack o' grain tied in the middle an' ridin' horseback.

"Ef there wuz any vackume in there, she shore hed a good chance to get out while I hung there doubled in two.

"Well, I tore a hick'ry shirt an' scraped my hide, but durn' a vackume did I see. I thought mebbe it hed slipped into the pump when the water went down, so I opened all the pump; but she wuzn't there to be seen.

"So I jes' closed up the heater an' pump an' went home ag'in. An' the next mornin' I tol' Mr. Hendersen Hillyer, the boss, what I thought of his dinged smart inspector feller. I sez, 'thet inspector feller comes 'raound here an' jes' makes you think he hez the wisdom of the seven wise men of Babylon. He comes up here with a lamp thet he puts little stones an' water in, an' kin crawl 'raound these boilers; you jes' think he's a whole dickshunary, don't ye?

"'He tol' you there was a vackume in the heater, an' I hed the heater open las' night an' looked through it, an' there ain't a blasted thing in there.'

"An' I'll tell ye, fellers, Mr. Henderson Hillyer didn't take well to my tongue, but what could he say? Vackume be jiggered!

"But I might's well tell you the rest. 'Baout nine o'clock thet mornin', they got to cuttin' purty heavy on the mill an' the injine got to snortin' loud, an', h'ist my galluses, ef thet pump didn't do the same thing ag'in. So I sez to myself, 'You're in there ag'in, are ye, Mr. Vackume.'

"But jes' then the boss came in an' saw the pump cuttin' capers. He sed to shut daown the mill, an' we got a small check valve thet useter be used on a feed line to a small boiler.

"We used the water gun (injector) to keep water in the boiler, an' we found a place near the top of the heater where we coupled up with a short piece of pipe, an' put the check valve on there backwards, like the pitcher on the pust card.

"Well, purty soon we got goin' ag'in, an' do you know thet ol' pump hez been travelin' along ever since, jes' as reg'lar like as a tax collector?"

Jabe bowed and sat down, and Uncle Dick, engineer at the handle factory, arose and said: "Brothers, I believe it proper that you have a brief explanation of the troubles and remedy Brother Hoskins had with the vacuum in his water heater.

"When the heater became filled with steam at times, and this steam condensed, a vacuum was created and the water would not flow properly to the pump; but, when the check valve was connected to the heater, as shown, when there was a vacuum created in the heater, the air pressure under the check valve raised it and allowed air to pass into the heater, thereby destroying the vacuum, as the boiler inspector had said."

The president then announced that at the next meeting Moze Billings, the engineer at Hemlock Hollow coal mine, would tell how he improved the main steam pipe in the boiler house.

U. S. CIVIL SERVICE COMMISSION announces an examination for shop apprentice to fill vacancies in the Bureau of Standards, Department of Commerce, Washington, D. C., at $720 a year, and in positions requiring similar qualifications, at this or higher or lower salaries. In the absence of further notice, applications will be received by the Commission at Washington, D. C., until the hour of closing business on Oct. 1, 1920. Applicants must have reached their sixteenth but not their eighteenth birthday. Age limits do not apply to persons entitled to preference because of military or naval service. Apply for Form 1312.

IN CONNECTING drip pipes to a trap, it is essential that the pressure in the common line to the trap is, at all times, less than that in any receiver connected to it, otherwise the flow will be interfered with.

Ice Plant Efficiency*

How Best Attained and Then Maintained. By H. C. Hayes.

THE MODERN ice plant is the electrically-driven, so-called raw water type, and each year sees more of the old style distilled water plants being changed to this newer class for the reason that, except in some special cases, the cost of operation is much less, and, of course, this is a step toward efficiency.

One of the most important things in the management of a plant is the yearly overhaul; this is an essential matter, too often gone through in a perfunctory manner, but one that invariably has its effect on the following seasons' operation. When the plant is shut down for repairs, each part must have careful and intelligent attention.

To begin with, the brine tank is a part of the plant too often neglected, and here results, good or bad, will be quickly shown. It is not always necessary in a carefully operated plant to clean the brine tank every year, but if a plant is operated 10 or 11 months continuously it should have this attention not less than every third year. Some tanks, depending on local conditions, need to be emptied and cleaned not less than every 2 yr. and sometimes every year.

If brine coolers are employed, the calcium brine must be carefully chosen and only that brand known as straight calcium should be accepted. Any kind containing chloride of magnesium should be refused, as the magnesium is precipitated by the slightest contamination of the brine by ammonia, and is carried along with the brine, like a sludge, stopping up brine cooler tubes and generally making itself obnoxious.

If brine coolers of shell and tube type are used, movable screens should be set up in front so that chips and dirt will not be carried into cooler tubes. While the brine tank is empty the cooler should be emptied of ammonia, pumped out from the top, not from the bottom, so that the ammonia may be distilled, leaving behind any impurities. When the cooler is nearly empty a false wooden bulkhead should be built over one end and a small amount of steam from the heating system be allowed to enter very slowly so that the entire cooler is heated gradually up to a temperature of about 125 deg. F. At this temperature the hand may be laid upon the shell without discomfort.

This heat will drive out practically all of the ammonia left in the oil and after pumping a vacuum of say 20 in. a couple of times, if the pressure does not rise quickly after the compressor is stopped, it is perfectly safe to blow out the cooler with an air pressure pumped from the compressor while the cooler is warm. As a general thing, you will find a great deal more oil in the cooler than you ever thought was there. This oil prevents the cooler working at anything near its real efficiency.

Choosing a correct oil is important. The oil should be one that does not thicken or solidify at the lowest temperatures used in ice plant practice and at the same time not be so thin and light that it will tend to gasify at the temperatures met with in the discharge from the ammonia compressor. An oil such as first mentioned will clog up small pipe lines, obstruct valves and generally resist all efforts to eliminate it after it has once gotten into the evaporator. An oil of the second fault will decompose and form permanent gases and force you to carry high head pressure with all its attendant inefficiencies.

If the brine tank is equipped with coils, they too must have some attention. The general practice is to blow them out with air after they have been properly emptied of ammonia. Care should be taken to blow each coil separately if possible. After blowing, all lines or apparatus that is to be submerged in brine must be given an air pressure test of about 150 lb.

The coils or cooler now having been cared for, the matter of agitation should be looked to. This is a most important matter. Each agitator should be carefully inspected and run at full speed empty, so it can be examined while running. Then the partitions dividing the tank should be looked to. We have seen some partitions so full of holes of various sizes that there was a tendency to short-circuit; also some partitions have been built so low that the brine laps over the top, which is another source of loss. In the first case, every hole should be plugged; in the second case, the partition should be raised high enough so the brine can't possibly get over.

Another frequent source of trouble is that in many coil tanks, along the outside rows of cans, a stand of coils is so spaced in the tank that a gap of 3 to 5 in. is left between this coil and the outside wall of the tank and the same space between the coil adjacent to the middle partition and the partition itself. This leaves four distinct pathways down the entire length of the tank that offer less resistance to the flow of the brine, than the relatively small spaces between the cans, with the result that a portion of the brine takes a path where it gives no benefit to the cans. This flow can easily be stopped by wedging a board between the coil and the tank wall at intervals of about every 15 ft.

The tank top and air system should also be inspected and any defects corrected. The sway stays in tank should be examined to see that cans will be held stationary and not swing with the current of the brine.

With these matters looked after, one can now examine the compressor. This should be looked over yearly regardless of what is done to the rest of the plant. The valves should be examined first. These should be removed carefully and examined and then ground to a true fit with carborundum and oil, and after being ground must be cleaned most carefully with kerosene and wiped dry to be sure that not one grain of the abrasive remains or it might cause endless trouble by getting into the cylinder.

Next, examine the piston and cylinder making sure that rings fit tightly and that cylinder is not unduly worn. Alinement of bearings should also be inspected and if found correct, the compressor may again be assembled, clearance adjusted and the rod packed. These are particular jobs and should have the attention of a skilled man.

The ammonia condenser should now have some atten-

*Abstract of paper presented at Spring meeting of Michigan Ice Industries Association. April 28, 1920.

tion. For most efficient ice plant work, this condenser should be of atmospheric type and of correct design, although there are, of course, special cases where other types appear the best, but for the rank and file of ice plants where the water does not seem to have a corrosive effect when dripping over the bare pipe, the atmospheric type will give less trouble and in the writer's opinion be much more efficient generally when the entire year's run is considered. The condenser should be inspected for leaks; if it is of the atmospheric type, these leaks will be easily found by going around the condenser with burning sulphur while water is shut off and pressure has been pumped up to say 200 lb. Ammonia will at once make its presence known by the dense white smoke that will appear when the ammonia meets the sulphur fumes.

In the double-pipe type leaks may be detected in much the same way. The condenser may be drained of water and one water bend removed on each stand and a burning sulphur taper held in front of the openings. Should ammonia be indicated from any one stand, of course, every water bend must be removed until the leaky pipe is found. A leaky double-pipe condenser is a serious thing, especially if the leak be through a porous pipe. If it is suspected that a slight leak through a porous pipe exists, the water leaving the condenser should be tested with Nesslers' Reagent, a preparation which may be secured from any drug store.

During the yearly overhaul, the plant operator should assure himself that all valves on the condenser are tight so that during the summer's run, should it become necessary to cut out a stand of condenser because of an accident, that he does not find himself confronted with the necessity of a complete shut down in order to isolate the affected stand.

For condenser purposes, in fact for all purposes around the ice plant where an amomnia valve is required in sizes up to and including 3 in., we believe the soft disc type of ammonia valve, that is, a valve having a disc made of a soft metal such as lead solder or soft babbit, should be used in preference to any other kind. An abundant water supply to the condenser must also be assured at all times. Then if a plentiful supply is available and a pump of sufficient size is installed, there are many things that must be watched very closely.

Most circulating pumps for modern ice plants are of the centrifugal type. These pumps will become inefficient if mistreated. Small chips, pieces of paper and many other small articles that find their way to the cooling towers *must* be kept out of the pump suction, as even a small chip will often become lodged in a pump impeller, thereby reducing its capacity and efficiency very materially. I believe in passing the circulating water through a screen after it leaves the cooling tower on the way to the condenser and again before it leaves the condenser pan to the pump suction. In spite of these precautions, a circulating pump must be carefully inspected and each vane of the impeller carefully explored for obstructions at least once a year. Also while down, the impeller should be carefully examined for wear at the points where the barrier is provided to prevent the water from "slipping" from the discharge back into the suetion. If a pump is worn in this fashion its capacity will begin to go down gradually until there is a visible reduction in the amount of water handled. This of course, knocks out efficiency, not only of the pump itself, but of the entire plant as well. Effort used in keeping the circulating pump up to its maximum rating is energy well spent.

Regarding operation. A plant in good shape is easily operated, although of course, some knowledge of the business is required. A few fundamentals should always be kept in mind.

First of all, be sure you have enough ammonia, and keep it in that part of the plant where it will work; no ice plant will run efficiently on a half charge. A plant with a correct ammonia charge, even if awkwardly handled, will often do better work than a plant with a short charge handled by experts. Keep enough ammonia in the plant so that there will always be a seal of 5 or 6 in., at least, above the outlet pipe of the liquid receiver under working conditions. Most receivers are constructed so that if the sight glass is half full of ammonia there is a seal over the liquid outlet. Keep coolers and coils full as possible.

One thing is certain, whatever else is done to secure efficiency, nothing will have a far reaching effect if the plant is running without a liquid seal.

Keep back pressures as high as is compatible with the temperature of the brine Keep the head pressure as low as possible. You are getting more effective work with each stroke of the compressor when head pressures are low.

Keep the compressor *running*. By running is meant up to its maximum speed and 24 hr. per day and seven days per week.

Never mind the falling temperature in the brine tank. Speed up the pull and unless your compressor is absolutely out of all proportion in size in relation to the brine tank, it will be found that enough heat can be added here to keep the compressor busy.

Don't let anybody keep a half dozen rows of ice frozen ahead in the brine tank. If reserve ice is wanted keep it in a storage house. A block of ice in an ice tank is taking up valuable room. *Get it out* and put a can of water in its place so that the plant will be producing something and not merely holding ice in cold storage. In fact, I do not believe in keeping a single block ahead in the tank at any time, that can be pulled. It is surprising how production can be boosted by the strict adherence to this homely rule and it is my experience and opinion that at the end of the year a productive plant in the fullest sense of the word will also be found to have been a highly efficient plant when all things are considered.

Regarding matters of pulling ice. The hand pushed crane is getting obsolete, and we prefer pulling three cans at once in a plant of say 60 to 90 tons and with a crane that not only hoists by power, but travels by power, the side shift may be done by hand.

Keep adequate records. By records I do not mean a mere record of the pull, but a daily record showing plant characteristics as well, and a weekly analysis showing operating costs per ton, of power, water and labor, at least. See that the engineer has a copy of this analysis. If you operate more than one plant, give engineer in charge of each plant a complete analysis not only of his own plant but of all the others as well. Watch them strive to beat the other man's record.

Air Receiver Ignition

THE ACCIDENT resulting from ignition of air compressor lubricating oil, described by C. E. Anderson on page 532 of the May 15 issue, furnishes an interesting problem, which, however, it is difficult to solve without additional data. Mr. Anderson was fortunate that the receiver did not burst, as has happened in accidents of this sort. A more serious accident might have resulted if it had not been the practice to blow down the receiver every night, thus removing most of the entrained oil.

The compressor referred to by Mr. Anderson is of the locomotive type. Evidently, from the sketch, it is not water-jacketed; hence, practically speaking, the air must have been compressed without extracting heat, that is, adiabatically. The air gage registered 65 lb. when the explosion occurred. That means that the temperature must have been very nearly 400 deg. F., in accordance with the accompanying chart. That would be the normal temperature if the compressed air at the inlet were 60 deg. F. and there were no cooling. At least two other factors, however, might have produced a higher temperature than this within the compressor, namely sticking of one or more valves and friction of piston against walls of the cylinder.

Presumably the valves were operated by difference of pressure. Hence sticking of the discharge valves might have permitted the pressure to build up way beyond 65 lb. before the valve could open. The sticking might be due to any number of causes, such as defective design, carbon deposits, warping or distortion due to overheating, dirt, etc. Increase of air pressure, of course, increases the heating to a marked extent, as is indicated by the curve.

Overheating due to friction of piston against the walls might be caused by a bent piston rod, an ill-fitting piston, too great speed of operation or scoring action due to dirt and dust. In connection with the latter trouble, I have seen a compressor in an up to date factory installed in such a way that the air inlet pipe projected vertically upward outside of the compressor house; it was absolutely unprotected and at every stroke of the compressor many particles of coal dust, soot, etc., coarse enough to be visible, could be seen to enter the inlet as they descended from neighboring factories. All that foreign matter must have played havoc with the cylinder walls and added materially to the friction.

Probably the fire referred to by Mr. Anderson originated in the cylinder of the compressor, because he stated that the discharge line from the air pump to the receiver was warmed up. If such was the case, the aftercooler arrangement which he proposes will not alone prevent future fires; but it might possibly quench the flames, once formed, as they pass the cooled surfaces. That, however, would depend upon the diameter and length of the water-cooled section, and the speed of the gases. By all means, use the aftercooler, because it will help to reduce the likelihood of flames traveling to the receiver. Furthermore, aftercooling is generally a profitable operation anyway; but I believe it would also be advisable to look to the cylinders, as well, as the possible seat of the trouble.

We have seen that the temperature of the air within the cylinder may have been considerably higher than 400 deg. F., but that was not necessarily the temperature of the lubricating oil. In fact, the temperature of the latter should have been considerably less for the

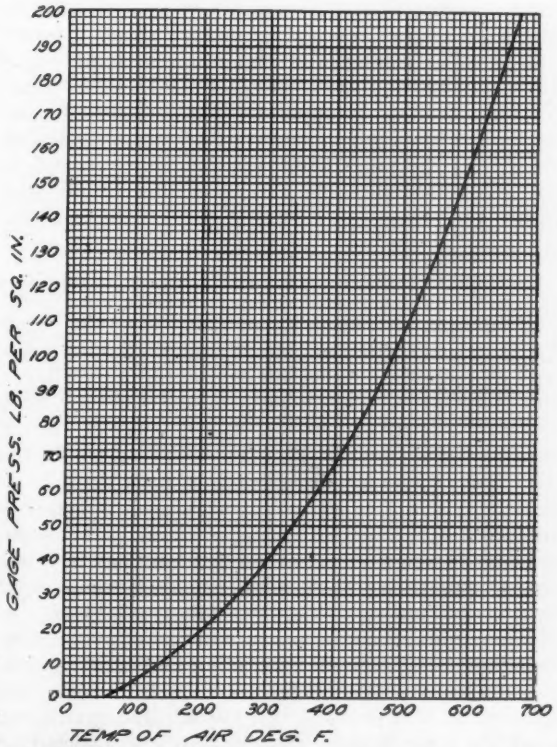


CHART SHOWING TEMPERATURE OF AIR UNDER ADIABATIC EXPANSION

reason that it was in contact with the walls of the cylinder. Air enters the cylinder slightly above the atmospheric temperature and then becomes heated to say 400 deg. during compression. If both the inside and outside of the cylinder were subjected to this range of temperature then the cylinder walls would attain a temperature midway between these two extremes, say 250 deg. The cylinder, however, is radiating heat to the atmosphere continually at, say, 60 deg., hence the inside

of the cylinder wall should have a temperature even lower than the figure assumed above. If a jacketless compressor is properly designed and run at the speed specified by the manufacturer, then the cylinder walls will radiate heat sufficiently fast, but if the compressor is operated faster than its rated speed, then the hot air will sweep the cylinder walls so fast and the friction of the rubbing parts will become so much greater that the cylinder walls will not be able to conduct away the heat fast enough and the lubricant may become overheated.

Speed is therefore of the greatest importance, especially in compressors of the unjacketed type. The Westinghouse Air Brake Co. recommends the following speeds for single stage unjacketed air compressors of various sizes, when running continuously against air pressures of 100 lb. or less per square inch:

Diam. of air cylinder, inches	8	9½	11
Length of stroke, inches	10	10	12
Rated speed, single strokes per minute	120	120	100
Piston displacement at rated speed, cu. ft. per minute	35	49	66

When, however, it is desired to increase the speed above the figures mentioned above for this particular make of compressor, then water-jacketed cylinders are often recommended even though the air pressure may be comparatively low. For example, high steam pressure or more rapid discharge of the compressed air might readily increase the speed way beyond the safe point. From this fact, it is apparent that unjacketed compressors are absolutely unsuited for certain classes of service. On the other hand, the company referred to above states that when the service is intermittent, that is, when the periods of work and rest are about equal, unjacketed compressors may safely operate against pressures as high as 150 lb. per square inch.

In the larger flywheel type of compressor, water-jacketing is considered very important, and some types very thoroughly circulate water around not only the barrel of the cylinder, but the ends as well. Cylinder water jacketing reduces the temperature of the air itself to at least a slight extent, but as not much of the air actually comes in contact with these cooled surfaces, the more efficient types of compressors rely more upon after-coolers, and in multistage compressors, upon intercoolers to accomplish most of the cooling of the air. The more important function of the cooling water is to assist lubrication by preventing overheating due to friction and by keeping the lubricant from becoming overheated, in which state it is more easily carried away by the compressed air, or converted into carbon and tarry matter.

Assuming that the jacket water is kept below the boiling point, it is probable that the lubricant would not exceed 250 deg. That is about the same condition that exists in a steam engine cylinder. The air, however, does not have the same tendency as steam to wash out the lubricant, hence less lubricant is required in an air compressor. It is a common fault to employ more lubricant than necessary for the proper operation of an air compressor, thus forcing the air to pick up the surplus and carry it along, perhaps to form an explosive mixture in receiver or piping. The writer has seen compressors so over-lubricated that the floor for several feet around the receiver was soaked from the oil oozing out through pipe joints. Different compressors require different quantities of oil and more is needed when the compressor is new than after it has had a few days' wear. The only reliable rule is to follow implicitly each manufacturer's instructions in the matter of air cylinder lubrication.

It will be interesting, nevertheless, to note the Ingersoll-Rand Co.'s recommendations for water-jacketed air cylinder lubrication, as follows:

Air Cylinder Size, Inches.	Piston Displacement Cubic feet per Minute	Quantity of Lubricant.
8 by 8	120	1 drop in 2 min.
12 by 12	320	1 drop in 1 min.
18 by 18	880	2 drops in 1 min.
24 by 24	1730	3 drops in 1 min.

The reader is cautioned against using the foregoing quantities of oil indiscriminately, for they may not be at all suitable for other makes of compressors. The same manufacturer recommends about eight times the above quantities of oil for steam cylinders of corresponding sizes, which fact illustrates the great difference between steam and air cylinder lubrication.

There is considerable divergence of opinion as to what is the best kind of oil for air cylinder lubrication. The Swan & Finch Co. makes two grades of lubricating oils with the specifications given below under items 1 and 2. The Ingersoll-Rand Co. recommends oil of the specifications noted under item 3 for compressors of its make operating under average duty. The same manufacturer states that only for abnormal conditions of high temperatures should oils having a flash point of 500 deg. and above be used owing to their tendency to produce carbon deposits.

TYPICAL COMPRESSOR OILS

No.	Gravity Baume.	Flash Test.	Fire Test.	Viscosity at 100 deg.
1	29 to 30	410 deg.	460 deg.	280 to 290 sec.
2	30 to 31	400 deg.	450 deg.	140 to 150 sec.
3	25 to 30	400 to 425 deg.	450 to 475 deg.	230 to 315 sec.

If the proper grade of oil is supplied in right proportion, little will be carried out with the air; in fact, so little that there should be no danger of an explosive mixture forming. The oil on the cylinder walls will not become overheated if the rated speed of the compressor is not exceeded. The discharge valves, however, present a different problem. They are exposed to the maximum or exhaust temperature continually and they have no opportunity to radiate their heat unless special provision is made for cooling them. As a result, if there is to be any trouble from carbonization it will usually be found to occur at or near the discharge valves. It is therefore a wise precaution to inspect these valves not too infrequently. Carbon of the valves and seats should be cleaned off and its recurrence prevented if possible by substituting more suitable oil. Should the discharge valves appear to be perfectly dry, it is probable that insufficient oil is being supplied.

Mr. Anderson stated that he employed mineral oil of a high flash test. The flash test under which oils are sold are made under atmospheric pressure. Oil in contact with air under a pressure of one atmosphere and under a pressure of five atmospheres are entirely different propositions In the latter case, the molecules

of the oil and of the oxygen in the air are in much closer proximity, or in other words, each carbon and hydrogen molecule is in contact with more oxygen molecules. The greater ease with which a given mixture of gas and air ignite under compression is well illustrated in the case of the gasoline engine. Hence, it is difficult to state at just what temperature an oil of a given fire test will ignite under compression. It has been noted above that the air in an unjacketed compressor becomes heated to a temperature not far from that of the flash point of the lubricant. Should it exceed it any time, due to abnormal operation, it seems that safety would be assured only by feeding the oil in such small quantities that there will not be enough to form an explosive mixture. Further, carbon and tarry deposits should be removed and avoided by using suitable oil, for they too are liable to ignite. Volatile oils like kerosene and gasoline should *never* be employed for cleaning air cylinders for the gases from them form a very serious explosion hazard. Heavy soapsuds have been used with good effect for cleaning out air cylinders.

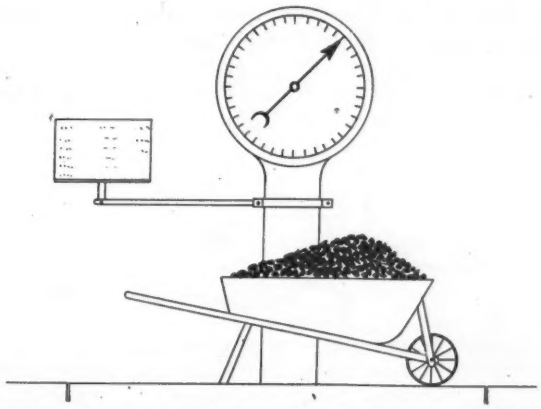
Mr. Anderson stated that the gage on his receiver showed a pressure of 300 lb. or more when the receiver ignition occurred. There is no way of figuring the pressure from the available data but it is instructive to compare the ignition to that in the case of a gas engine cited in Kent's Handbook. That engine (6 by 12 size) developed a maximum pressure of 220 lb. per square inch when the pressure before ignition was 41 lb. gage pressure and the temperature before compression, after compression and after ignition were 60, 313 and 2800 deg. F., respectively. In this case, the compression pressure was only 41 lb. as against 65 lb. in Mr. Anderson's receiver and there must have been more loss of heat through the gas engine cylinder walls than through the walls of the air receiver. Hence, assuming similar mixtures of air and gas and the same compression the final pressure would have been somewhat above 220 lb.; but it hardly seems likely that the pressure in Mr. Anderson's receiver went much above 300 lb.

A flame once started is likely to be propagated with great rapidity through the pipes into the receiver and perhaps even further, presenting under certain conditions a very serious fire hazard if not an explosion hazard. Hence, too much stress cannot be laid upon the importance of following the manufacturer's instructions implicitly, particularly as regards (1) employing a suitable grade of lubricant, (2) regulating the oil feed in accordance with the instructions even though it may appear to be too meager, (3) cleaning receiver frequently and compressor periodically, (4) avoiding the use of gasoline or kerosene for cleaning, (5) piping the intake air so as to have it clean and cool, (6) preventing the cylinder walls from becoming overheated due to too great speed of piston travel or due to utilizing an insufficient supply of cooling water (in the case of a water-jacketed compressor) or by installing it so that it is exposed to excessive heat (particularly in the case of an unjacketed compressor). CHARLES C. PHELPS.

An Aid in Keeping Accurate Coal Records

IN THESE days, practically every well run plant is making some effort to keep track of the amount of fuel used. This usually involves weighing the coal in barrows on scales, which usually are of the platform type so that the coal barrow or truck can be wheeled on for weighing. In our plant, we followed this method, but found that there was an inclination on the part of the coal passer to try to carry the weights in his mind and then enter up five or six loads at a time on the record book. This was because the record book was hung on the scale upright and it meant walking around the scale platform each time to enter a weight.

Because of the possibility of error in the memory system, we overcame this condition by putting an extension on our scale, as shown in the accompanying illustration. This was nothing more than a 5-ft. extension



SHOWING HOW TALLY SHEET WAS CONVENIENTLY PLACED AT THE END OF A LONG ARM

made of 1-in. angle iron fastened to the scale upright and carrying on its end a small, light board large enough to carry the coal tally sheet, right handy where the coal passers could mark it down immediately when they set their barrows down and noted the weight on the dial. We also arranged this arm so that it could be swung around to the opposite side for use when weighing our ash on test runs. M. A. SALLER.

Cutting the Speed of Pumps

UPON ENTERING an engine room, the visitor is surprised to see the many gages and pressure recording devices which adorn the walls of that department. He will then be shown the different instruments which are used in the economical operation of the plant.

The engineer will explain to him the importance of such-and-such an instrument in the saving of fuel or steam. The engine is seen to be working very smoothly, and the engineer will show the visitor some very fine cards taken that day.

But as they are standing looking down on the jet condenser pump which is going faster than the need may be, the engineer explains that the efficient operation of the engine is due to that piece of apparatus.

Now perhaps the man on duty thinks that in order to hold the vacuum at 25 or 26 in., it is necessary to keep the pump speeding; this, however, is not so.

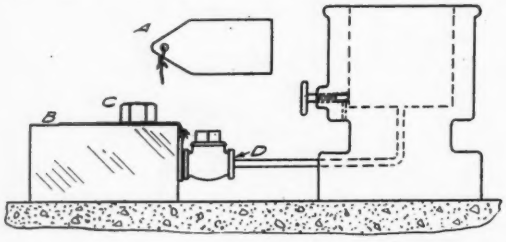
Right here steam may be wasted just the same as it is in any other case. If the operating man will try to slow down his pumps, he will find that the vacuum will still hold if the proper amount of injection water is supplied.

In many plants, sometimes as many as seven or eight engines are run condensing. It is easily seen that if each pump is slowed down, a considerable amount of steam will be saved. Go around your plant and see where your pumps are consuming too much steam for the work done. CLEMENT COREY.

An Emergency Check Valve

WHEN COMING on duty one night recently, the smaller unit was running and at the usual hour I started the larger unit, a Corliss engine, not knowing that the day man had been working on the dashpot and check valve. When the engine turned over, this dashpot hit the bottom with terrible force and upon examination, I found that the check valve had been put back without a seat.

The peak load was at hand and no check valve available, and no time was to be lost in getting the larger unit going, so this is what I did.



METHOD OF EMPLOYING RUBBER DISC AS CHECK VALVE SUBSTITUTE

A piece of gasket rubber, A, was cut about 2 in. square and a string tied to it. A brick was set about 1/8 in. from the check valve and the rubber swung between the brick and the check and held by nut C as shown. We went through the load as if nothing had happened. J. L. YOUNG.

Filing System

FROM TIME to time articles appear in these columns from different readers on the subject of filing magazine clippings; some of these articles are interesting and have merit, which prompts me to offer a suggestion along that line and feel that it will be useful to many so interested. Take one good business letter file for every subject to be covered, one for Boilers, one for Engines, Generators, Pumps, Compressors, Refrigeration, Heating Systems, Sprinkler Systems, Electric Wiring and Telephones, Valves, Piping, Fittings, etc., as many files as required to cover fully the respective plant and this, in most cases, will be about 12 files. Over the usual word on the outside of the files, we will paste a lettered sticker designating the contents; say we begin with BOILERS, as these are the mainspring of the steam-operated plant. Opening the file, we paste on the inside of the cover a typewritten description of the boilers in the plant, giving size, rated capacity, construction, pipe sizes and fittings and any other information which will have a bearing on the boilers or boiler room and if possible the age of the boilers should be given. Then on the outside of the first pocket, we paste an index to contents, using the letters in the file which are required to cover the subject and these may be indexed as follows:

A—Arches—Angles—Anchors, etc.
B—Boilers—Bridge Walls—Blowoffs, etc.
C—Casings—Coverings—Cleaning, etc.
D—Dampers—Doors—Draft, etc.
E-F—Economizers—Expansion—Furnaces—Fittings, etc.
G—Grates—Gaskets—Gages, etc.
H-I-J—Inspection, etc.
K-L.
M—Manholes, etc.
N-O.
P-Q.
R—Rivets—Riveting, etc.
S—Safety Valves—Settings—Stacks—Stays—Seams, etc.
T-U-V—Tubes—Valves, etc.
W—Water Columns, etc.
Adveftisements.

There are some pockets which will not be used in every subject as is the case with Boilers and therefore we remove such divisions making more room for other clippings, we also remove X Y Z and use that pocket thus made for Advertisements on the subject covered. In this way, we have a compact inventory of our boiler plant with a complete information bureau always at hand and new clippings can always be added by a careful selection and rearrangement of the collection on hand.

Then we take the next subject, Engines, and treat it in like manner, using another file for the purpose, and on the inside of the cover we give all information relative to the engines in the plant even down to the size and name of the packings used as well as the foundation construction if possible; then we take the pumps, generators, etc., and thoroughly cover each subject, indexing each file and using the last pocket formed by the removal of the X Y and Z for Advertisements.

In water power plants, the same idea can be carried out, using as many files as necessary to cover the plant but using only one file, or, I should say, putting only one subject or information pertaining to one line of apparatus in each file. Before putting the files in use, they can be treated to a coat of shellac or light varnish which will protect them from dirt and grease in contact with which they are sure to come in the busy day of the average engineer. I think that this idea is far better than the "Scrap Book" method; for upon rearranging the collection, any articles not required can be discarded and room made for more useful ones and it also allows for the keeping of advertisements along with the subject covered and from time to time these advertisements can be rearranged when new apparatus is put on the market by advertisers and the old ads become obsolete. CHAS. L. RIECKE.

Examination Questions

THE FOLLOWING QUESTIONS may be of considerable interest and value to one contemplating taking an engineer's examination.

1. How would you determine the highest safe working pressure on a horizontal boiler?

2. How would you determine the area of a lever safety valve. Pop valve?

3. How could you determine at what pressure a lever valve was set to blow off? A pop valve?

4. How would you figure the number of braces required to support properly the flat surface above the tubes of a horizontal boiler?

5. Give dimensions for rivet joints for single, double and triple riveting. Also size of rivets required for 5/16, 7/16 and ⅜-in. metal?

6. Give pitch of stay bolts, also size for bracing area 20 by 32 in. of ⅜-in. plate to sustain 120 lb. pressure.

7. How many rivets are in a unit of double riveted seam? Triple-rivet butt joint?

8. How much water will a horizontal boiler 72-in. diameter, 18 ft. long, with 70 4-in. flues hold?

9. What is the best way to set two 60-in. boilers? Give thickness of walls, spaces and such dimensions as are necessary.

10. Describe how you would make an internal examination of a horizontal boiler; an external examination.

11. What is your opinion as to causes of boiler explosions and what would you do to minimize the hazard?

12. Where is the steam cutoff in a pump? Can the valve motion be made to cut off earlier?

13. How would you determine the size of pump to supply the boiler and the size of delivery pipe and suction?

14. If a pump, which was in good condition and had been giving good results, should suddenly fail to deliver water, what is the cause?

15. Which would you prefer, a simple slide valve or an automatic cutoff engine, both having the same speed and size and doing same work? Why is there any difference in horsepower?

16. How would you determine the size of steam and exhaust pipes to supply an engine properly?

17. How would you change speed of slide, automatic or Corliss engine?

18. How would you go about setting valves on a Corliss engine? What angle would you set eccentric with crankpin?

19. If the governor belt was slipping, what effect would it have on the engine?

20. If you were running under normal conditions and a thump should develop in your engine, what would you do? E. G. M.

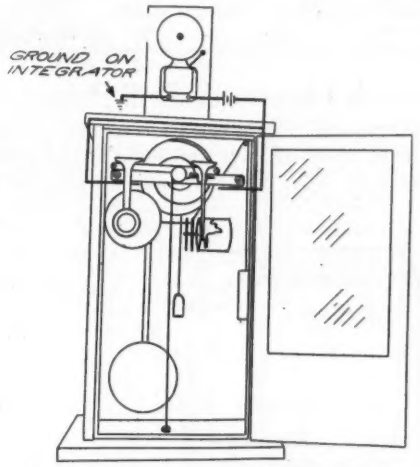
Alarm for Flooding Feed Meter

THE ACCOMPANYING sketch shows a telltale alarm I use on a Cochrane recorder. I have much trouble with my boiler feed heater flooding, caused by scale on the valve, which is a piston V-notch valve, float controlled. This valve controls the water from the upper chamber through the metering chamber and on to lower or suction chamber. When our water load goes for 15 or 20 min. without change, then the valve sticks. On the next change if we cut back, the heater floods. If we open up, we soon have a dry heater.

The heater is so arranged that nobody can see how it is operating without making a trip to the heater room, which is over the pump room.

This bell device is grounded on the frame of the integrator on one side; the other side has two leads, one to each end of the spiral cam track. They can be made fast here to a piece of spring brass with the ends curved down to make contact with the lug under the pen carriage. These leads must be insulated from the track.

The leaves can be set above and below the range of the water flow, so the bell will not ring when you have a high or low drop in water load. When the valve sticks now, the water only rises a few thousands flow before



ALARM FITTED TO FEED-WATER METER

the bell rings, which can be heard from all departments in the plant. Somebody then gives the float-valve lever a shake and she is all right until another spell comes on.

W. M. ALMOND.

Turbine Makes Duration Record

NOTING IN recent issues articles on the long runs of turbines, the following may be of sufficient interest to readers.

One of the steam turbines in the plant of the Mercer County Light, Heat & Power Co. has just finished a run of 139 days without being shut down.

This machine also ran 334 days on 27 gal. of oil, the temperature of the oil leaving the bearings not being over 152 deg. F. at any time.

This turbine is 750-kw. horizontal Curtis.

R. L. MOSSMAN.

Dame Nature vs. the Engineer

NATURE IS often called Dame Nature, which means that nature is a woman. I believe it because women can't be understood and neither can Nature.

For example, wherever you go or whatever you do you invariably have to fight for what you want. Nature has a tendency to give you the opposite of what your heart craves.

Piston rods and cylinders are made nice and smooth in the first place and it is our desire to keep them so, but little old Dame Nature takes a hand in the affair and does all she can to make Sir Piston Rod and Sir Cylinder Walls rough. Same is true of bearings, valve surfaces, the rails in our railways, and so on *ad infinitum*.

On the other side of the fence, we have friction drives that were made rough in the first place; but Dame Nature is opposed to roughness there just for the sake of contrariness, and lo and behold, the surface soon be-

comes smooth. A file is made rough, but does it stay rough? Even gears have a tendency to wear down smooth. Mother Nature sometimes tries to make gears smooth by breaking the teeth off. Very often, you see, she is hasty and doesn't use good judgment.

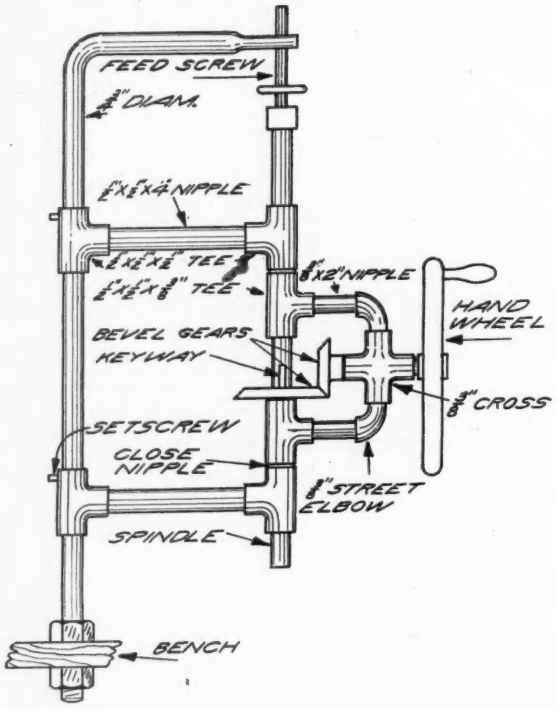
If you want to keep a thing sharp, you can't do it without constantly opposing nature. If you want to keep a thing dull, look out or it will get sharp.

Nature is a woman, without doubt.

W. F. SCHAPHORST.

A Homemade Drill Press

THE ACCOMPANYING illustration shows a drill press which can be made of odds and ends of material found about the shop. The body is made up of pipe fittings.



DETAILS OF EASILY MADE DRILL PRESS

The column consists of a piece of ¾-in. round iron or shafting 34 in. long, bent at right angles 6 in. from the top end. This short end is flattened somewhat and drilled and tapped for the feed screw. The latter is connected to the drill spindle by means of a swivel joint, so as to permit the spindle to revolve independently of the screw.

The spindle can be made about ⅝ in. in diameter, and must be provided with a long keyway in the portion which carries the bevel gear. The lower end is drilled centrally to take small drill shanks, which are held in place by a set screw tapped in from one side. The lower gear is provided with a tightly fitting key which slides easily in the keyway in the spindle. The positions of the gears relative to each other may be adjusted by the use of washers or collars between them and the bearings. Adding a hand driving-wheel and babbiting the bearings completes the machine.

L. T. MCCOY.

Misplaced Key Causes Motor Trouble

OUR SHIPPING clerk, who is also chief master mechanic (?), took a motor apart the other day. It was a small fractional horsepower machine but, nevertheless, it required the same judgment that a regular man-size motor would require in overhauling. On the pulley end was a small pulley fitted by a key and this had to be removed in order to remove the armature. The shipping clerk took it apart and laid the shaft key on one of the pole pieces. When he replaced the armature, he

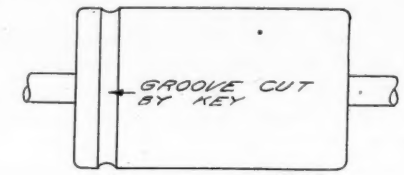


FIG. 2

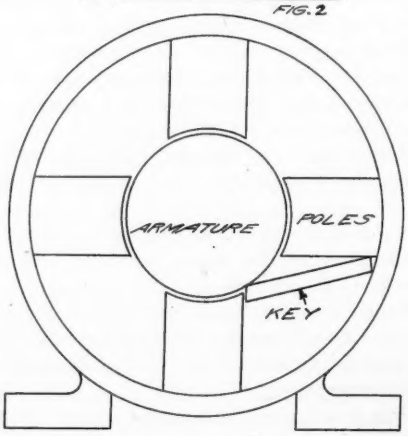


FIG. 1

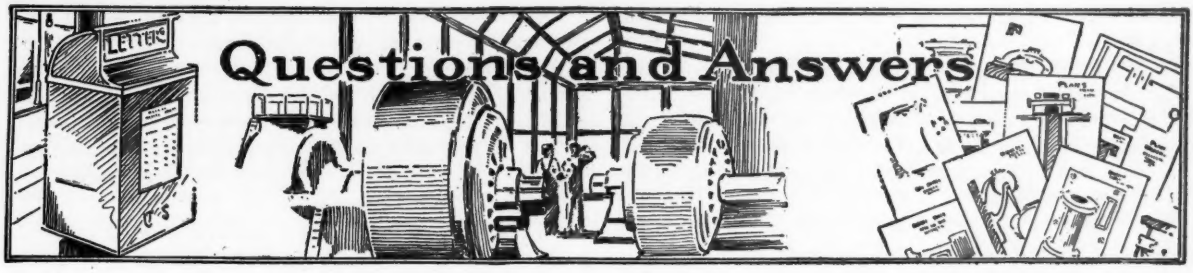
FIG. 1. POSITION OF KEY IN MOTOR
FIG. 2. EFFECT OF KEY ON ARMATURE CORE

left the key on the pole piece, then went and bought a new key. This motor ran for several days although I don't see how it ever did it. Figure 1 shows how the key was found. It is evident that when the current (d.c.) was turned on, the key was carried off the pole and lifted into the position shown. This particular key is about six times the clearance from armature to poles in thickness.

R. G. SUMMERS.

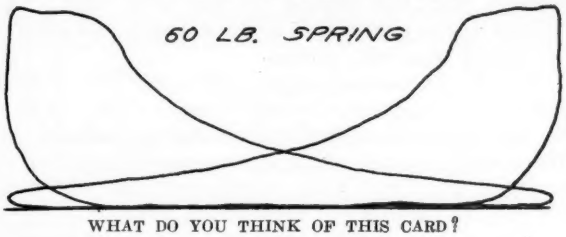
U. S. CIVIL SERVICE COMMISSION announces examinations, Aug. 4-5, Sept. 22-23, Nov. 3-4, for local and assistant inspector of boilers and local and assistant inspector of hulls, to fill present and future vacancies in the Steamboat-Inspection Service, at salaries ranging from $2100 to $2950 a year. Appointees at annual compensation of $2500 or less may be allowed the temporary increase granted by Congress of $20 a month. Applicants must have reached their twenty-fifth but not their fifty-fifth birthday on the date of the examination. Persons entitled to preference because of military or naval service are released from age requirements. Apply for Form 1087, stating the title of the examination desired.

PLAY IS work made pleasant by the incentive. For a happy life, get the proper incentive; it lies within your own door.



Wanted—Criticism

I SUBMIT the accompanying indicator diagram to the readers of Power Plant Engineering for criticism and suggestions as to how it can be improved.

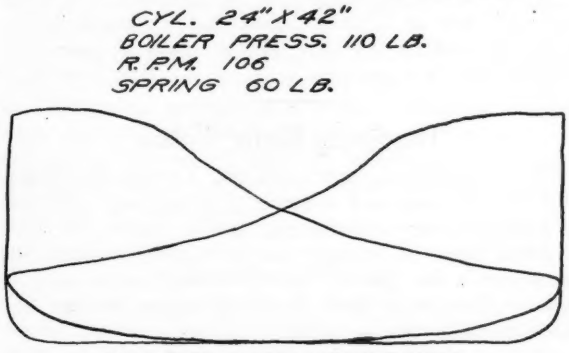


WHAT DO YOU THINK OF THIS CARD?

TOM JONES.

Engine Pounds

WHEN OUR Wetherill engine developed a pound, we took the accompanying indicator card. We moved the exhaust eccentric ahead about 1½ in. on the shaft (the shaft is 14¼ in. diameter) and it seemed to make the pound worse. What suggestions have readers to make for eliminating this pound?



CARD FROM ENGINE WHICH POUNDS

A. B. C.

Building Up Field

I NOTICE on page 628 of the June 15 issue, H. E. S. is having trouble with his 200-kw. exciter which, at times, seems to lose its residual magnetism. I assume that H. E. S. is running this machine at its full rated speed, because on a slow speed the machine would not build up properly. If there is too much resistance in the field circuit of this machine it will not build up. I suspect this is the cause of his trouble. I question whether the machine really loses its residual magnetism; I have a suspicion that resistance is unknowingly placed in the circuit, due, perhaps, to dirt accumulating on the commutator and the brushes.

I would suggest that, when the machine fails to build up, H. E. S. sandpaper the commutator and brushes making sure of a clean commutator, clean brushes and a good brush fit. Also he might see that his brushes have enough pressure on the commutator surface. There is another thing which may be partly at fault, and that is the contact on his field rheostats. These, if they are not clean, may introduce enough resistance in the circuit to cause his trouble. Needless to say, perhaps all rheostats should be cut out of the field circuit in starting so that the machine will have every opportunity to build up.

VINCENT CHADWICK.

Filter Problem

ACCORDING to the diagram given by J. T. in the July 1 issue, I note that the filter basin is 96 ft. in length and 30 ft. in width, giving a total filter surface area of 2880 sq. ft. For general conditions, it is only common practice for the gravity type of filter, such as illustrated, to operate at a filtering rate of 2 gal. per min. per sq. ft. of filter surface area. On this basis, 5760 gal. per min. would be obtained, and, therefore, it is only to be concluded that the filter is entirely too large for the requirements of handling 950 gal. per min.

J. T.'s diagram and the way he has worded his question indicate that he has given this subject some little thought; but the indication also is that he has not gone far enough, for he has failed to take into consideration the subject of how the filter is to be cleaned.

In connection with municipal or water works filtration plants of the gravity type, the filter basins are seldom, if ever, larger than 10 ft. by 18 ft.; there is a reason for this, as will be explained, and I shall try to make this clear by applying it to J. T.'s conditions.

A gravity filter having a capacity of 1000 gal. per min. based on a rate of 2 gal. per sq. ft. of filter surface per minute would contain a total of 500 sq. ft. This could be a basin 10 ft. wide and 50 ft. long; however, it should not be constructed in one large basin, but rather in a number of basins—for instance, each 10 ft. square, of which there could be five. I am dividing the filter into five 10 by 10-ft. filters, assuming that he has a pump capacity of only 1000 gal. per min.

While a gravity filter operates at a 2-gal. rate while filtering, the same filter can be properly washed only by reversing the flow from downward to upward. This upward flow or washing rate should be at not less than 8 to 10 gal. per min. per square foot of filter area. Therefore, the 1000-gal. per min. pump can be sufficient for washing only one of the 10 by 10-ft. sections at a time.

Whatever a filter removes from the water, it retains, and this matter removed from the water must in turn be eliminated from the filter bed. The most common prac-

tice and that recognized as best is in accordance with what I have outlined above.

I shall not attempt to explain how the parts of the filter should be proportioned or designed, because these are matters to be gone into by somebody experienced in the construction of filter plants, and whoever handles this work for J. T. should have a complete understanding of his conditions.

J. T. does not indicate in his question that he has considered coagulation in connection with his filter plant, and, as it stands, it is no more or less than a strainer and not a filter. Filtration and coagulation are so closely associated that there is very little difference. This I will make clear by calling attention to the fact that water contains very fine particles of suspended matter that are extremely tiny; in fact, so very small that in comparison with the sand grains, the sand grains become boulders. Consequently, these fine particles would pass through a filter and remain in the filtered water, if coagulation is not used.

Coagulation is the application of a chemical, such as sulphate of iron or sulphate of alumina. Either of these chemicals reacts with the natural alkalinity of the water and forms another substance, which may be described as a heavy, sticky precipitate. This precipitate gathers to itself the very finest particles of suspended matter, and these, together with the precipitate, are removed by the filter from the water. Without coagulation, most waters cannot be filtered with any degree of success whatsoever.

Accordingly, it is my idea that J. T.'s apparatus, as shown by the diagram, serves no other purpose than to remove or strain from the water large particles such as might be affected by the means of a wire screen. In time he might, however, secure some filtering action due to the layer of sediment that would surely deposit on top of his filter bed and which would serve to some extent as a natural coagulant, but he would soon obtain a condition of clogging that would stop the operation of his filter; then he would be out of luck, because there is no other means of cleaning it outside of getting into the bed with a shovel and throwing out his filtering material and then replacing with new. This, of course, would not be practicable. W. J. Hughes.

Using Metallic Packing

In answer to Tom Jones' letter of June 15, I will state that it is better to put new metallic packing on a new rod than to trust any rod to a fibrous packing. I have in my charge at present ten engines ranging from 2000 to 100 hp. Four of these are twins so that you see I have some rods to look after. It has been a custom of the engineers of this plant to put a ring of fibrous packing on top of the metallic when the latter started to leak a little. The result was nine beautiful scored rods with shoulders, grooves and some slots in them.

Since I have been on the job, I have turned the rods down and put on new metallic packings. In about 3 to 5 hr. after we start up, we have no more leaks and by the next week end (Sunday) we have a beautiful polish on our rods. While I do not recommend cast-iron packing rings since I have used the babbit packing ring, I did run two sets of cast-iron rings for 6 yr. that never gave me a bit of trouble.

In reference to two new surfaces wearing, well, I say, get them together, as one of our large engine companies starts its new cylinders up with new rings and pistons when you can feel the tool marks in the cylinder. The company's logic is that they become a good, smooth, perfect fit just that much quicker. Surely it must pay.

H. Arthur Van Fossen.

Several years ago, I had a piston rod taken out and ground to size. It was a perfectly smooth job; much smoother than soft packing could ever make it and the metallic packing blew badly. The company that made the packing installed it, so it was not the fault of my workmen that the packing did not work right. The packing was no experiment, as the company had made it for several years with success.

Finally the packing expert said to me (the packing had been in operation several years): "Mr. Thumb, the trouble with this job is that you had the rod ground. There were no rough spots on it to wear the packing to a perfect fit. Don't grind a rod again, but turn it to size and the packing will never fail to work."

I have never ground a rod since, though I have installed metallic packing at different times, and always put it on the rod directly before soft packing had a chance to injure it. If I have trouble with a metallic-packed rod blowing, the medicine I apply is a piece of fine emery cloth drawn around the rod in one or two places. This generally has the desired result. It roughs the rod and the rough spot in passing through the packing wears it to a fit in short order.

I do not use an oil cup on soft packing, but swab with graphite as I believe, also, that too much oil injures the packing, though I lubricate metallic rods from the outside when possible. Tom Thumb.

Removing Boiler Tubes

On page 675 in July 1 number, I notice the Massachusetts questions and answers. For anybody not used to making repairs on horizontal tubular boilers, the third question might be a puzzle; but after going through this maneuver a few times, it will be found much easier to remove the lower tubes and pull them through the manhole.

This may, to the uninitiated, sound a bit peculiar; but if tubes are coated with scale, as quite often is the case, it will be found easier to pull the tube a few inches, cut off, push back in and drop down, than to try to pull the full length. Ordinarily about 10 to 12 times as many tubes may be removed in this way in the same time, as pulling clear through. I prefer to retube about six or eight in the center of the sheet before pulling all tubes.

I would suggest that question six might allude to the equalizer pipe often used, the question coming so close to the Holly return system.

On page 671, M. A. Saller shows a waterproof box for protecting flywheel belting from water in pit.

We have boiler plate guards for the same purpose and though the first cost is high, the insurance against stoppage is worth the price.

Mr. Fuller, page 669, believes that there is something wrong with the young men of today. He thinks the lure

of short hours, high wages, clean work, etc., should not take them from the engine room, but shortly afterward he says: "If I could get them, I would employ only young men, etc." Then, where would the old man who had worked faithfully for Mr. Fuller for 15 or 20 yr. fit?

I, for one, don't in the least blame the young man for accepting the short hours, clean, cool work at more money, instead of a hot, greasy engine room with less money but more promises. I dare say Mr. Fuller has worked 12-hr. shifts seven days a week and thoroughly enjoyed it (so have I, and 16 hr. more per week, at times); but today the young men have been educated differently, they hear the 8-hr. hum from the time they can understand the first few words until they get big enough to go to work, and perhaps if 8 hr. is enough work at one time in a factory it is in the engine room—who shall say?

TOM THUMB.

Reducing Grate Surface to Save Coal

IN VIEW of the fact that the heating season is now practically over, it has occurred to me that possibly I might be able to save considerable coal by bricking up part of the grate surface of our 125-hp. boiler. During the non-heating months, only part of the boiler capacity is required.

Taking into consideration the cost of the fire brick and labor required to do this work, is it your opinion that the net result obtainable would warrant making these changes?

R. W.

A. We will say that within certain limits it will be possible for you to brick up a portion of your grates so as to reduce the quantity of coal burned during times of light steam demand.

If this is carried too far, however, while you would burn less coal, you would nevertheless burn a greater amount of coal per pound of water evaporated. Thus, while your over-all cost would be reduced, your cost per unit steam generated might be increased. We would recommend not to cover your grates to a greater area than from 25 to 35 per cent.

Smoke Problem

THE ARTICLE by A. R. K. under the caption, "A Smoke Problem," reminds me of a similar installation in which I had some experience while serving my time on "the firing line."

The steam blowers were installed for the purpose of burning a large quantity of hard coal screenings which the company had purchased at a low figure. This system of forced draft was in operation at the time of my engagement with the company, and was my first experience in firing boilers equipped with this system. But after I had received quite a severe burn, which left numerous blisters on one side of my face, singed my hair, burned one arm and set my clothing on fire, I was declared to be duly initiated and entitled to receive all the rights and privileges enjoyed by the rest of the crew.

This burn was caused by the blowback caused by the breaking of one of the boiler damper chains while the blowers were in operation, and this experience caused me always to be sure that the dampers were open before opening a furnace door when the blowers were in operation. I earnestly advise all others to take this precaution.

We succeeded in burning what screenings were not either blown up the stack or deposited in the combustion chambers, and the system was continued in operation for some time after we had begun receiving our regular run of coal.

Our system of firing was the same as that mentioned by A. R. K. and we certainly made our share of smoke.

It appeared to us that a large percentage of steam was being blown into the ashpits instead of going out the steam main, and as the stack afforded ample draft for the boilers, it was decided to try cutting out the blowers and using the natural draft and fire in the proper way. This was done by cutting out one at a time and watching results; we found that we furnished less smoke for the community at large, burned less coal and maintained a better steam line.

In firing spasmodically as with the blowers, the fires get in bad shape before the blowers start, with more or less holes in them, and light in spots, then a large quantity of green coal is put on which is bound to make smoke even with the natural draft, and the forced draft only tends to aggravate the evil. If the forced draft must be used, the fire should be kept bright and coaling should be done frequently, as when using natural draft, not depending on the blowers for the signal for firing.

As A. R. K. states he has sufficient natural draft for his boilers, I would suggest that he try cutting out his blowers, and we would be pleased to hear from him in regard to results in some future issue of Power Plant Engineering.

E. C. W.

A. R. K. ASKS ADVICE as to what methods to use or what changes to make to overcome his smoke nuisance.

There may have to be changes made in the furnaces or baffles; but first I would suggest trying a change in the method of firing. The blower has a leeway of 5 lb. in stopping and starting which may vary from 5 to 10 min. according to the load and the amount of fuel fired, during the time the blower is stopped, the fuel bed is not getting the proper amount of air to keep it in an incandescent state, consequently the furnace temperature is lowered. When the steam pressure drops sufficient to start the blower, there is a fresh charge of fuel fired, as this fuel is cold and contains a certain amount of moisture, which must first be heated to evaporate the moisture which causes the distillation of the volatile matter in the form of gases and vapor. These require oxygen for their combustion in order to develop heat and as the fuel bed is probably carried too thick, the oxygen cannot be supplied through it, but must be admitted through the furnace door. If these gases come in contact with the cold surfaces of the boiler before they are properly mixed with this secondary air, their temperature is lowered below their ignition point and the unburned combustible matter passes up the chimney in the form of smoke.

You can eliminate a large per cent of the smoke that issues from your chimney by careful firing. I would suggest that the steam pressure be kept between 105 and 110 lb. so as to keep the blower operating continually; by doing this, there will be an even flow of air through the fuel bed, keeping the fuel in an incandescent state

which will produce a more even furnace temperature. In following up this procedure, I would start with a light fire and build it up gradually until you have the proper depth of fire to keep the steam pressure and carry the load. When you have accomplished this, proceed to fire light and at short intervals keeping the fire even and at the proper depth on the entire grate surface. We can not regulate the proper amount of air to the furnace to have efficient combustion without having an analysis of the flue gases and I would advise that this be done while carrying out this procedure.

C. J. MILLER.

IT IS my opinion that A. R. K.'s furnace setting is O. K., judging from the sketch. It must be borne in mind that a high furnace temperature is essential to good combustion. The opening in the small door on the fire-door may be too large, so that air enters in a large stream that is more likely to cool the small proportion of the gas that it reaches below its ignition temperature (1800 deg.) than it is to promote its combustion.

Much more satisfactory results are obtained when the door is provided with special openings that serve to divide the entering current of air and distribute it over a considerable part of the grate. The perforated inner door is particularly useful in this respect. If the demand for steam is moderate and regular, the coking system of firing should prove a help toward eliminating smoke. If there is great demand for steam and the spreading system of firing must be used, best results will be obtained by firing light charges at frequent intervals. The habit many firemen have of covering the incandescent coke on the grate with a thick layer of fresh coal naturally results in lowering the furnace temperature far below the ignition point of the hydrocarbons driven off. In consequence, there is an enormous waste of heat, and with bituminous coal, vast quantities of black smoke are produced.

GEORGE R. COSTE.

Thawing Out a Brine Cooler

I WOULD LIKE to know if there is any way to thaw out a double-pipe brine cooler which sometimes freezes up, owing to the brine getting weak. The plant is of the compression type. The man in charge at this plant thaws it out with the ammonia some way, but apparently does not want me to find out how it is done. I am, therefore, asking your assistance. W. G.

A. Before answering this question, it is best to state that every known precaution should be taken to prevent the freezing of the brine in a double-pipe cooler. The loss of ammonia is not the only item to be considered. The flooding of the ammonia compressor with brine and so causing a serious wreck is a danger that must be considered.

In plants where the double-pipe type of cooler is used, salt brine should not be used. Calcium is best and safest, as it is possible to carry very low temperatures and still take no chances of freezing up.

Salt brine, of a density that shows 100 on the salinometer, will freeze at a temperature of 1 deg. F. above zero. Chloride of calcium, of the same density, will not freeze until a temperature of minus 15 deg. F. is reached.

Now, if we consider the actual temperature of the ammonia that is being evaporated in the brine cooler, we will see how close we are to the freezing point of the salt or calcium solution that is circulated. When the back pressure gage shows 15 lb. pressure, the temperature of the ammonia is just about zero. So, with salt brine of a density of 100, it is not safe to operate the compressor with a back pressure of 15 lb. if double-pipe coolers are used.

Use calcium brine and insist on salinometer readings being taken morning and night; also insist on the density being kept at 100, as shown on the salinometer.

If such precautions are taken, the cooler will not freeze unless the circulation of the brine is stopped. The brine circulating pump must be dependable. Do not take chances by using a pump that has a habit of stopping once in a while.

Now, if the brine does freeze, the first thing to do is to shut both the expansion and suction valves on the cooler. If the suction valve is left open after the expansion valve is closed, the back pressure will be lowered and the temperature of the ammonia will also be lowered.

By closing both valves, the ammonia temperature rises rapidly, as the imprisoned ammonia will assume a higher pressure.

If the brine is not frozen almost solid, it will begin to circulate in not longer than 10 or 15 min. The expansion valve can be opened just a little for the fraction of a minute and so still further increase the pressure and temperature; this will hasten the thawing process.

A hot gas connection is convenient for thawing out brine coolers and also for removing frost and ice that accumulate on the outside. This is simply a ½-in. connection between the discharge side of the ammonia compressor and the cooler. Insert a tee, nipple and valve in the ½-in. line between the expansion valve and the cooler and extend the line to the discharge line close to the compressor.

Either to thaw out the cooler or to remove the frost, close the expansion and suction valves and open the hot gas valve. In something like 5 min., the thawing or frost removing is done and the hot gas valve is closed. Then open the suction valve just enough so the ammonia is heard passing through. Leave the valve in this position for several minutes until the danger of flooding the compressor with liquid ammonia is passed.

Then notice the temperature of the discharge line. If there is liquid coming from the cooler, the line will be cold. When the discharge line gets hot, open the brine cooler suction valve slowly.

A. G. SOLOMON.

Waterproofing Cisterns

WE ARE BUILDING a cistern having brick walls and a cement floor. How can I waterproof this? J. M. H.

A. There are several waterproofing compounds on the market. We also quote a paragraph on this subject from "Machinery's Handbook":

"The asphalt fluid coatings for reservoir walls, concrete foundations, brick, wood, etc., are often of use to engineers. Asphalt only partly dissolves in petroleum

naphtha, but when heated in a steam-jacketed kettle and not thinned out too much, a mixture of the two may be obtained in which the part of the asphalt not dissolved is held in suspension. Asphalt is entirely soluble in benzol or toluol, which are about the cheapest solvents for all the constituents of asphalt. Tar and pitch are sometimes used in this connection, but tar contains water, light oils and free carbon, and does not wear as well as good refined asphalt; pitch also contains free carbon, which is sometimes objectionable when it is thinned out with a solvent. Asphalt alone is somewhat pervious to water, but it can be improved in this respect by adding about one-fourth its weight of paraffine; it is also well to add a little boiled linseed oil. For thicker compositions, where body is required, asbestos, stone powder, cement, etc., may be added as fillers. Lutes of linseed oil thickened with clay, asbestos, red or white lead, etc., are waterproof if made thick enough. These are much used for steam joints. Flaxseed meal made into a paste with water is often serviceable, the oil contained serving as a binder as the water evaporates."

Engine Alinement and Other Questions

How does an automatic damper regulator work and how is the water supply regulated?

2. Describe the passages through which the steam flows when a pop safety valve is blowing off.

3. Is babbit used in worn-out boxes? If so, how is it prepared?

4. How does a Bundy trap operate?

5. What will cause an engine to pound on the crank end?

6. What will cause an engine to pound at the crosshead?

7. How would you line up the cylinder of an engine?

D. McC.

Answers

An automatic damper regulator consists essentially of a steam-operated diaphragm which is connected in such a manner that with a movement of about 1/10 in. the lever will operate a water valve a distance of about ½ in. This water valve controls the water which opens and closes the damper as the steam pressure rises and falls.

2. When a pop safety valve operates, the steam passing through the valve seat goes into the valve chamber which is made of such proportions that it maintains a back pressure sufficient to prevent a chattering of the valve. From here the steam either passes directly into the atmosphere or through some form of pipe.

3 Babbit is frequently used in replacing worn-out boxes. The composition of babbit is variable, ranging from a metal containing considerable copper to one composed mainly of lead, depending upon the conditions under which it is to be used. In rough work it is sometimes possible to treat the shaft so that no babbit will adhere to it and then pour molten babbit around the shaft. A slight scraping then makes the bearing ready for use. In a better class of work specially turned mandrels are used of a size slightly smaller than that of the shaft which is to run the bearing. In this case, the bearing requires boring to render it fit for use.

4. The Bundy return trap is one in which the condensate flows from the steam pipe through a check valve into the bulb of the trap, causing the latter to be depressed. As the bulb falls, it opens the steam valve by means of a lever fastened to the other end of the bulb arm. This allows steam to enter the bulb and blow the water contained therein into a pipe which allows it to fall by force of gravity into the boiler.

5. Pound in the crank end of an engine may be due to excessive wear in the bearing or the crankpin and may be increased by lack of cushioning effect of the steam. This latter would be caused by no lead having been given the steam valve.

6. Pound on crosshead might be caused by the same defects as mentioned in question 5 and might also be increased by excessive compression as well as wear on the guides or crosshead.

7. There are several ways in which the alinement of the shaft and cylinder may be checked. Nearly all modern engines have "spots" planed on the inside of the frame opposite the crank, and parallel to the center line of the cylinder. When this is the case, it is only necessary to caliper between one "spot" and a point on the crank disk or end of the crankpin as most convenient, then turn the crank over until the same point on the crankpin comes opposite the other "spot" on the frame and caliper here. If the shaft is in line or square with the cylinder, the two measurements will be the same. If not, one end of the shaft must be moved to bring them equal. If no "spots" are planed on the frame the shaft may be alined in the following manner:

Take off the cylinder head, and bolt a strip of wood to one of the studs so that the end will extend out past the cylinder, and about as high as the center of the cylinder. From this stretch a fine line or wire to a support beyond the crank shaft. This may be a post fastened to the floor, or a piece of wood fastened to the wall at the same height as the center of the cylinder.

Now measure the distance from the center of the counter-bore to the line at the end outside the cylinder, then lay off the same distance from the center of the piston rod and move the line up to it, then draw the line taut and fasten. This will make the line parallel to the center line of the cylinder. Then stretch a second line parallel to the center line of the shaft and at the same height as the center, fastening it to supports as before. Square this line with the line first set, which may be done with a square or by the proportions 3, 4, 5. The latter is the best method, and is done as follows:

Measure off 3 ft. on one line from where the two lines cross and tie a string on the line here. Then lay off 4 ft. on the other line and tie a string here; when the two lines are at right angles to each other the diagonal distance from one string to the other will be 5 ft. After the line is set correctly, measure the distance from the center of the crank shaft to the line on each end, and adjust the shaft accordingly. The accuracy of this method will depend on the accuracy of your measurements. If the piston, piston rod, and crosshead have been removed the line can be run through the cylinder but the line outside will do as well if care is taken to get the measurements correct.

Over five thousand are killed and 50,000 are injured annually as a result of fire.

POWER PLANT ENGINEERING

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A Compliment

In the present conditions of unrest and self-seeking, it is refreshing to note the commendation given by the daily press to the spirit which engineers and their organizations are manifesting.

In a recent issue of the Worcester, Mass., Gazette, the purposes of the Stationary Engineers of New England are endorsed in no uncertain terms. Part of the editorial follows:

"The professed objects of this association, namely the promotion of harmony between industrial plants, the development of the spirit of co-operation between manufacturers and increasing wages by making men more efficient and productive, are in line with the foremost thought of the present day. The idea carries with it the solution of the trials and tribulations of the aftermath days of war; this country needs a new birth of devotion to the ideal of individual efficiency and individual productivity. There is no bound to what a man can earn in wages if his efficiency is equal to his initiative and strength. The world is longing to pay men high wages for high grade work. What it objects to is paying more for less hours, less output, less value received.

"Teaching such a gospel as is professed by the National Association is a direct and lasting service to the workingman; his best friend is the man who helps him mount and stand upon a solid and reliable basis; no man is on a solid basis who is rich in demand and lean in product whether he gets what he wants or not, and any organization which furthers such teaching is not doing the greatest service; the best friend the workman has is the organization which shows how he can do more, create more value, deliver a better product. For, however things may operate in eccentric days, such as those we have been through, the old laws of supply and demand will reassert themselves. "By their fruits ye shall know them" is an old, old adage, but it holds good. The capitalist and the laborer, alike, must come under its unbiased decision.

"Would that capitalists, too, might belong to organizations seeking for themselves what this New England States Association of Stationary Engineers is seeking for the workman—more efficiency, a better grade of output; for with these must always come more and more remuneration."

Setting a Goal

An industry is, in one respect at least, like an army. To gain success and general advancement objectives must be set which once gained will point to other objectives farther on in the line of progress. The power plant industry is no different from others in this respect, but from an engineering standpoint the goal is quite definitely set at 100 per cent conversion of one form of energy into another. Of course, we do not expect to reach that goal, but the industry as a whole has a long way to go before it even approximates the known practical limits of efficiency.

After careful observation of conditions as they exist in the power plants of the country, a short list of objectives has been made, the full attainment of which will undoubtedly bring us closer to that ideal 100 per cent.

This list printed in the box on this page under the heading Power Plant Slogans will appear regularly here in each issue as a reminder of the fact that the attainment of these practices throughout the entire industry will be a great improvement over present conditions. From time to time, as our campaign for better conditions seems to warrant, the list will be changed or added too, as it is only part of this list that may fit the individual needs of your plant; but we hope that with this suggestion every one of our readers will set a goal in his own plant, plan improvements by which to reach that goal and use his influence to bring other plants up to an equally high or higher plane.

Power Plant Slogans

Store Coal in Summer.
Keep and Analyze Operating Records in Every Power Plant.
Develop Water Power Sites.
Promote Health and Safety in Power Plants.
Handle Coal and Ashes Mechanically.
Employ Engineers for Engineering Work.

Off Duty

"What's all this noise we have been hearing about sending a rocket up to the moon? Are there really individuals, silly enough to take stock in such ridiculous notions?"

Of course there are—and more power to them. Let us hope they continue their "ridiculous" experiments While we do not take it upon ourselves to predict a "Daily Lunar Express" or "Special monthly commutation rates to the moon," our views are not so narrow as to prevent our encouraging those working on the problem.

If for no other use, the mere fact that knowing that it can be done will be of value to science. But no one knows what such an accomplishment might lead to. It would not be the first time in the history of science that the time and energy spent on an apparently useless thing proved of inestimable value. In the early days of vacuum lamps, Mr. Edison noticed the peculiar fact that from a hot filament a low current would always flow to a metal plate located within the lamp.

To some people, this fact might have been of small importance and they perhaps would have disregarded it. But to those whose interest ran high enough to study this peculiar phenomena came the reward of immortal fame, and today we telegraph and telephone across the Atlantic without the aid of wires, and in the laboratory, the x-rays have revolutionized our views on matter and energy. And in the same manner that the remarkable success of the two inventions referred to above can be attributed to the close study of the apparently useless phenomena which Edison observed in the incandescent lamp, so are countless other conveniences of today, the result of research in fields where at first the possibilities of success were exceedingly slight.

But we have digressed. We started to talk about sending rockets to the moon, and the probability of success in that direction. In the first place, where did the idea originate?

In the process of securing meteorological data in the higher strata of our atmosphere, various means are employed to send up the recording instruments. In the course of work of this nature, it was suggested to send them up on a vehicle propelled by explosives or, in other words, a rocket. Suppose we have a mass of explosive material of as great an energy content as possible, what height can be reached if a large fraction of this material is shot downward on exploding with as high a speed as possible? It is evident, intuitively, that the height will be great if the fraction of material that remains is small, and the velocity of ejection of the gases is high.

And it was found in the experiments by Prof. Goddard that by means of a suitably designed nozzle, the energy of the motion of ejected gases as compared with the heat energy of the powder could be increased greatly over that for ordinary rockets. The highest average velocity being nearly 8000 ft. per sec.

An interesting way of emphasizing the magnitude of this velocity is to compare it with the "velocity of escape" or the parabolic velocity of planets. The velocity of escape is the velocity a body would require projected upward from a planet in order to escape to infinity, and it depends upon the mass and the diameter of the planet. For the moon this velocity is 1 5 mi. per sec. and for Mars it is 3.0 mi. per sec.

Thus if the chamber described above were fired from the moon, most of the gases would escape from the moon's attraction. The highest velocity gases would also, no doubt, escape from Mars if that planet had no atmosphere since 8000 ft. per sec. is only the average velocity of the gases.

As was stated before, the more important and immediate application of the machine is in providing a simple and inexpensive means of obtaining meteorological data. It will be readily appreciated that any means of sending recording instruments rapidly into the extreme heights of our atmosphere and obtaining data soon after ascent will be of immense value, not only in weather forecasts, but of scientific importance as well in the study of aurora, during the day as well as at night.

"And how could we know whether it ever reached the moon?"

Simple enough. A few pounds of flash powder exploding on the surface of the moon would be visible in a telescope of only 1-ft. aperture. Tests in Auburn, Mass., on a fairly clear night proved that the burning of one-twentieth of a grain of flash powder could be seen at a distance of 2¼ mi.

By all means let us encourage Prof. Goddard to proceed with his experiments. Columbus was ridiculed, and Benjamin Franklin was thought mentally unstable when he sent up his kite in a thunder storm. It is to such pioneers of science that we owe our many conveniences and our present state of progress. We can always learn something.

We'll admit that the man in the moon must have a hard time getting air to burn his coal (the moon is said to have no atmosphere) yet he could probably give us a few pointers on securing a high vacuum.

Duplex Convention at Worcester

POWER PLANT AND COMMERCIAL ENGINEERS CO-OPERATE. BY JOSHUA O'LEARY

THE ANNUAL convention of the New England Branch of the National Association of Stationary Engineers in conjunction with the New England Association of Commercial Engineers was held in Worcester, Mass., on July 7, 8, 9 and 10.

The local committee of arrangements, of which Mr. Robert Johnson, chief engineer of the Worcester Cold Storage Co., was the chairman, had evidently labored with intelligence and enthusiasm in effecting the preliminary arrangements and the result was the staging of one of the most successful and satisfactory conventions yet held in New England.

The place provided for the exhibition of power plant machinery and supplies was the extensive building known as the Casino. This was centrally located, easy of access, and its large stretch of space, free from pillars or other obstructions, afforded ideal facilities for the display of the wonderful aggregation of power plant men, Chairman Robert Johnson, President Charles E. Hildreth of the Worcester Chamber of Commerce, and Fremont S. Eggleston, Jr., of the exhibition committee.

Lieutenant-Governor Cox pointed out with keen appreciation the highly important contribution made to the business efficiency and industrial progress of New England by the men of the organizations participating in the convention. He expressed strong approval of the principles and business methods of the engineer organizations and closed by extending to all the delegates and members a cordial greeting and hearty welcome from the Commonwealth of Massachusetts.

On Thursday evening the first session of the N. A. S. E. delegates took place at the Bancroft. It was called to order by Warren Goodrich, president of the New England Branch, N. A. S. E. Addresses were made by President Goodrich, President Charles E. Hildreth of the Worcester Chamber of Commerce, Dr. Ira N. Hollis,

appliances presented for inspection in more than a hundred booths. The exhibition hall was decorated with graceful festoons of colored bunting radiating from a central point in the high arched roof The booths were uniform in shape and decorated with a pleasing color scheme of green and white. At the evening sessions, a profusion of electric lights, some of which took the form of elaborate colored designs, added interest as well as brilliancy to the scene.

Power Plant Engineering occupied a corner booth at the center of the hall and was a point of interest to visitors from all parts of New England, where the magazine is exceedingly popular with the power plant people.

A few rods from the exhibition building is the Bancroft, one of the most modern and best appointed of New England hotels. The use of its ball-room had been secured by the committee for convention sessions and the entertainment of the delegates and their friends.

On Wednesday evening there were opening exercises at the Casino, brief addresses by President Harry H. Atkinson, Lieut.-Gov. Channing Cox, Maj. James W. Myrick, President Fred A. Minor of the Board of Alder-

president of the Worcester Polytechnic Institute, Elmer L. Dean, vice-president of the New England Association, Herbert Stone, past national president, and Alderman Joseph Leyden, representing the Mayor.

In his address, President Hollis expressed optimistic views regarding the unrest in labor and business circles in the United States. He deprecated exaggerated apprehension of dangers in the foreign elements of the population and said that the great heart of America was sound and could be depended on to function successfully in the future as in the past. He dwelt at length and with much earnestness on the need of thrift, productiveness and conservation of the national resources. He gave reliable statistics to indicate the limitations of coal and other natural resources and urged conservation not only as an immense advantage to those now living, but also as an imperative duty to posterity.

At the close of the address, reports of committees were made. All showed progress and the present satisfactory condition of the organization. Nothing of unusual interest developed until the report of the License Committee was reached.

That report showed that the committee, by its chairman, had attended hearings at the Massachusetts General Court and had strenuously opposed the effort made to amend the state license law so as to permit the running of power plants by one licensed engineer with unlicensed assistants. It was shown that after having been adopted by the Senate, the amendment vote was reconsidered and rejected by a majority of one. This vote also was reconsidered, but the rejection was sustained by two majority. In the debate on the acceptance of the report, it was shown that the determined effort made to change the license law resulted from the shutting down of several large manufacturing plants in New Bedford by a small number of firemen seeking some advantage for themselves. The strike was not approved by the engineers and other employes, but, as the law prevented the employment of unlicensed firemen, the strikers were able to inflict serious injury on the other employes as well as on the manufacturing interests of the city. The consensus of opinion, as manifested in the debate, seemed to be that it would be inexpedient for the organization to oppose some modification of the law if similar conditions should occur in the future. No definite action was taken beyond an agreement among the delegates to work for harmony on their return home.

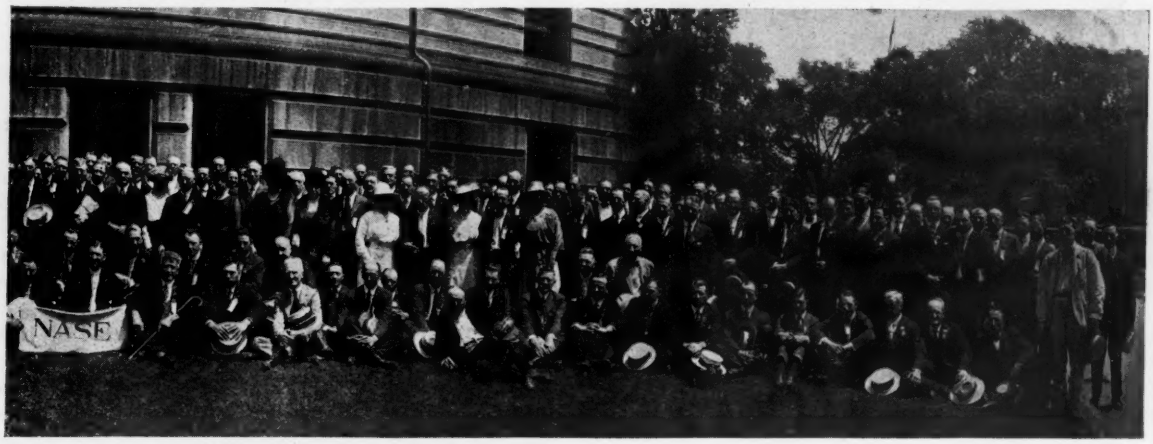
On Saturday morning the delegates were given an automobile tour of the city which included visits to factories and places of interest.

At noon, the delegates were taken in special cars to Winchester's boat house, near Lake Quinsigamond. They were entertained with a baseball game, athletic contests and an excellent "sheep-bake" which was fully enjoyed and highly praised by all who participated. During the dinner, a fine musical program was rendered.

A word of special praise is due to the following firms who despite the great difficulties of transportation encountered were prompt in opening their exhibits. Their display has rarely been equalled and perhaps never been exceeded in the experience of the N. A. S. E. conventions.

The exhibitors follow:

American Pulley Co., American Steam Gauge & Valve Mfg. Co., Anchor Packing Co., V. D. Anderson & Co., Ashton Valve Co., Autoforce Ventilating System, Babbitt Steam Specialty Co., E. B. Badger & Sons Co., Barber-Greene Co., Bernitz Furnace Appliance Co., Braman, Dow & Co., Brierly & Lombard Co., Alfred L. Brown Associates, Budd Grate Co., Builders Iron Foundry, A. Burlingame Co., Calebaugh Self-Lubricating Carbon Co., Carling Turbine Blower Co., Wm. D. Cashin & Co., Central Supply Co., Chapman Valve Mfg. Co., Climax Smoke Preventer Co., Crandall Packing Co., Crane Packing Co., M. T. Davidson Co., Dearborn Chemical Co., Drake Non-Clinkering Fire Block Co., Eagle Oil & Supply Co., Economy Engineering Co., Economy Fuse & Mfg. Co., Economy Lubricating Co., Edison Packing &



The business meetings were completed Friday afternoon with elections of officers by the two organizations. The new board elected by the stationary engineers is as follows: President, Dudley S. Kimball, of Cambridge; vice-president, George C. Mattson, of Worcester; secretary, Freeman L. Tyler, of Taunton; treasurer, Walter L. Damon, of Springfield; conductor, John R. Graham, of Fall River; doorkeeper, Thomas Livingston, of Meriden, Conn.

The commercial engineers chose officers as follows: President, H. H. Atkinson; vice-president, Sanford C. Smith, of New York; treasurer, Joseph W. Mirick, of Boston; directors for three years, Fremont S Eggleston, Jr., L. A. H. Merrithew and F. A. Couch, all of Boston.

The place for the next convention was not definitely settled, but will doubtless be Providence, R. I.

Members of each of the associations proved themselves clever entertainers by the parts they took in the entertainment program Friday evening in the Bancroft ballroom. Professional performers from some of the local theaters also took part.

Sales Co., Eggleston Supply Co., Electric Storage Battery Co., Engineer Company, Everlast-Hart Co., Federal Gauge Co., Fiber Finishing Co., Files Engineering Co., Flint Mixture Fire Brick Co., France Packing Co., Garlock Packing Co., Girtanner Engineering Corp., G. M. C. Engineering Co., Graton & Knight Mfg. Co., H. and H. Motor Specialties, Inc., A. W. Harris Oil Co., Jos. W. Hayes Corp., Home Rubber Co., Imperial Packing Corp., Jefferson Union Co., Jenkins Bros., H. W. Johns Manville Co., Keystone Lubricating Co., King Refractories Co., Lakewood Engineering Co., Lead Lined Iron Pipe Co., Lee Clay Products Co., Locomotive Superheater Co., Lubron Co., Lunkenheimer Co., Manning, Maxwell & Moore, Inc., Mason Regulator Co., McClave-Brooks Co., McLord & Henry Co., Monarch Soot Remover Co., Nashua Machine Co., "National Engineer," New Jersey Asbestos Co., New York Belting & Packing Co., Nightingale & Childs Co., Otis Elevator Co., F. S. Payne Co., Perfection Grate & Supply Co., Perolin Co. of America, Philadelphia Grease Mfg. Co., Pioneer Rubber Mills, "Power," "Power Plant Engineering," Pratt & Cady Co., Inc., Quaker City Rubber Co., Quigley Furnace Specialties Co., Republic Flow Meters Co., Sanford Riley Stoker Co., Rockford Sprinkler Co., Roto Co., Schumaker Santry Co., Smith Engineering & Supply Co., "Southern Engineer," Stines Screwhole Co., Strong, Carlisle & Hammond Co., Streubing Truck Co., Under-Feed Stoker Co. of America, Union Water Meter Co., United States Rubber Co., Vacuum Ash & Soot Conveyor Co., Voorhees Rubber Mfg. Co., Walworth Mfg. Co., Washburn & Garfield Mfg. Co., Watts Regulator Co., Wetzel Mechanical Stoker Co., William R. Winn, Worcester Electric Light Co., Worcester Gas Light Co.

Concrete Tanks Prove Success for Oil Storage

DURING nearly 2 yr. test, three concrete tanks, at the Trafford City foundry of the Westinghouse Electric and Manufacturing Co., built in the summer of 1918, have proved satisfactory as fuel oil containers. Recently, one of the tanks was used to store transformer oil, and held the light-flash oil as easily as the heavy fuel oil.

Each of the tanks has a diameter of 37 ft. with a capacity of 125,000 gal. Built of reinforced concrete, the tanks have successfully resisted the weather and the little seepage that occurred was easily stopped. Recently the tanks were inspected by a representative of the United States Bureau of Standards, who is making a study of the use of concrete tank for storing oil.

The tanks have been used to store oil for use in both the foundry and the work at East Pittsburgh, Pa., a small pumping station being used to drain oil into cars for shipping. It is thought that, as the first tanks have proved so successful, other concrete containers will be installed as needed.

OIL STORAGE TANKS AT TRAFFORD CITY

U. S. CIVIL SERVICE COMMISSION announces open competitive examinations for assistant examiner, Patent Office, Aug. 4, 5 and 6; Sept. 22, 23 and 24; Nov. 3, 4 and 5, to fill vacancies in the Patent Office, Washington, D. C., at the entrance salary of $1500 a year, with temporary increase granted by Congress of $240 a year, to appointees who perform satisfactory service, and vacancies in positions requiring similar qualifications, at this or higher or lower salaries. All citizens of the United States who meet the requirements, both men and women, may enter this examination; appointing officers, however, have the legal right to specify the sex desired in requesting certificates of eligibles. Competitors will be examined in French or German, mechanical drawings, technics, covering the general field of mechanics, mechanic arts, industrial arts and processes, and applied chemistry, and two optional subjects from list presented. Age, 20 yr. and over on date of examination. Apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.

International Power Economy Conference

THE executive committee on organization appointed in November, 1919, to draft a constitution and conduct a campaign for 100 contributing members has issued a prospectus and outline, and is now undertaking the membership campaign.

The purpose of the Conference as stated is: To urge the perpetuation and extension of the work of conservation carried on by the U. S. Fuel Administration during the war. To promote a better understanding among producers of light, heat and power and the general public of the necessity for fuel conservation. To co-operate with power plant owners in order to increase plant efficiency. To do whatever is necessary to bring Congress to realize the importance of this work so as to secure the needed financial support and the authority of some departmental bureau (preferably the Bureau of Mines) to take over and direct the work.

Members are to be of three classes: (1) Active, including manufacturers of power plant equipment, power plant owners, members of the engineering profession and publishers, or the representatives of any of these. Each company can have only one active member. (2) Associate, including representatives of manufacturers, plant owners, engineering organizations or publishing concerns. (3) Honorary; such dignitaries or holders of public office as may be approved for this class by the active membership.

Dues of active members are $100 and for associates, who have all privileges except the right to vote, $10.

Officers are a president, three vice-presidents, to represent manufacturers, advisory organizations and power plants, and a secretary-treasurer. Management is to be in the hands of an executive council, consisting of the president, the chairman of each of the sub-committees and the ex-president. Officers, except the secretary who is appointed by the council, are to be elected by ballot, the president for 1 yr. and vice-presidents for 3 yr., one each year. Also one-third of the members of the council are to be appointed each year, but the sub-committees and the method of their appointment are left for later provision after the Conference is organized.

An annual meeting is to be held during the first week in November of each year.

The report is signed by the temporary executives, C. A. Tupper, chairman; F. G. Bolles, executive secretary, and by the Committee on Organization, Joseph Harrington, chairman; R. J. Stewart, L. A. Griffin, Cass Kennicott, Jos. W. Hayes and A. W. Patterson.

Applications for membership can be sent to R. J. Stewart, treasurer of the committee, 1737 So. Michigan Ave., Chicago, Ill.

THE PRESENT campaign on the part of certain interests to bring about the adoption of the metric system by legislation brings to mind the story of the action of a certain legislature in the olden days in its efforts to simplify and improve the order of things. Having had brought to its attention the incommensurate relation of the circumference to the diameter of a circle, a vote was passed to the effect that in the future, the circumference should be 3 1/7 times the diameter.

U. S. Civil Service Commission announces examinations as follows: Junior Engineer, Grade 1, $1500 to $1920 a year; Junior Engineer, Grade 2, $720 to $1440 a year; Junior Architect, $1320 to $1920 a year. Competitors will be rated on physical ability, education, training and experience. Applications will be received until further notice. Apply for Form 1312, stating the title of the examination desired.

News Notes

The Yale & Towne Manufacturing Co., New York, announces the removal of its general offices to Stamford, Conn.

The Ball Engine Co., of New York City, has moved its offices from 39 Cortlandt St. to the Vanderbilt Building, 132 Nassau St., New York City.

The Strong, Carlisle & Hammond Co., Cleveland, Ohio, manufacturer of steam specialties, announces the removal of the Chicago office to 17 South Desplaines St.

The Homestead Valve Manufacturing Co., Homestead, Pa., announces the removal of its New York office, which is in charge of P. L. Rhodes, to 242 Lafayette St.

Manning, Maxwell & Moore, Inc., New York City, has incorporated a new concern, which will be known as Western Manning, Maxwell & Moore, Inc., and will open a store in San Francisco at 40-42 Fremont St. C. H. Overkamp will be Western manager.

On July 1 Chas. A. Schieren Co. gave a showing of a new industrial film at the Machinery Club in New York. This new set of films can be secured for the asking by any responsible body of men who have the facilities to show them.

Geo. A. Woolley, aged 57 yr., district manager of General Electric Co., and well known Denver club man, was found dead in his summer home at Evergreen, Colo., 21 mi. from Denver. Physicians stated death was due to heart disease. Woolley was born in Long Branch, N. J., April 5, 1863. He was district manager for the General Electric Co. since 1893. He was a member of the Rotary Club, the Denver Athletic Club and several other organizations.

S. F. Bowser & Co. held its regular annual sales convention June 28 to July 2, inclusive, in honor of the 1919 members of the Pacemakers' Club. Membership in this Club is a reward for securing 500 points of business based on volume and class of equipment sold. No conventions were held during the war, for patriotic and conservation reasons, and so it was decided to make the next one a general convention, including all salesmen regardless of whether or not they were members of the Club.

The convention was held for the benefit, inspiration, and entertainment of the sales force, everything possible being done to make it a success. Aside from the general spirit of loyalty and patriotism which was in evidence at every meeting, there were two specific demonstrations which are of interest. As a surprise to the factory force, the salesmen pinned on the bosom of each workman a unique badge of honor. The purpose was, of course, to secure a better understanding between the man on the "firing line" and the producer. A gasoline filter demonstration was made, proving that the filter removes all dirt and water from gasoline automatically.

Several appointments have been made in the organization of the Westinghouse Electric International Co. At East Pittsburgh they are as follows: H. F. Griffith, Assistant to General Manager; R. W. Everson, Manager of Merchandising Department; H. C. Soule, Manager Apparatus Department; and H. S. Reizenstein, Manager Price Department. In New York they are: G. H. Bucher, Assistant to General Manager; J. H. Payne, Supervisor of Agencies; and F. M. Sammis, Manager of Incandescent Lamp Department. A. B. Cole, Assistant Manager, Department of Publicity, Westinghouse Electric & Manufacturing Company, has been placed in charge of the advertising and promotion work for the Westinghouse International Company.

The Combustion Engineering Corporation announces the appointment of Henry Kreisinger, formerly of the United States Bureau of Mines, as Engineer of Research. While with the Bureau of Mines Mr. Kreisinger compiled a large proportion of the government pamphlets on fuel and combustion problems, and his years of experience in government service will be of incalculable value in his new position.

He will conduct investigations of a similar nature to those that he conducted for the government; and the results of his work will not only be available to the clients of his corporation, but will also be supplied to the government. This branch of the corporation's business is entirely aside from any commercial consideration and its activities governed by precisely the same fundamental principles that underlie the operation of the Bureau of Mines. The only difference is that Mr. Kreisinger will have a broader field for his studies because of his being able to apply them to practical situations, and, further, there will be less financial limitation.

U. S. Civil Service Commission announces examinations for engineer examiner, class A, $3900 to $4800 a year, and engineer examiner, class B, $2220 to $3600 a year, to fill vacancies in the Interstate Commerce Commission, Bureau of Finance, under the Interstate Commerce Act, at the salaries indicated, and in positions requiring similar qualifications, at these or higher or lower salaries. Appointees at annual compensation of $2500 or less, whose services are satisfactory, may be allowed the temporary increase granted by Congress of $20 a month. On account of the needs of the service, papers will be rated promptly and certification made as the needs of the service require. In the absence of further notice, applications for this examination will be received by the Commission at Washington, D. C., until the hour of closing business on Oct. 1, 1920. If sufficient eligibles are obtained, the receipt of applications may be closed before that date, of which due notice will be given. An applicant shall be not less than 25 nor over 45 yr. of age, and shall have been in the active practice of his profession for at least 6 yr.; and he shall have

had charge of work as principal or assistant for at least one year. Graduation from a school of engineering of recognized standing shall be considered as equivalent to 2 yr. active practice. Apply for Form 1312, stating the title of the examination desired.

U. S. Civil Service Commission announces an examination for electric draftsman to fill vacancies in the Office of the Chief of Engineers, War Department, Washington, D. C., and in positions requiring similar qualifications at the following salaries: Grade 1, $1200 to $1500; Grade 2, $1500 to $1800; Grade 3, $1800 to $2400. Appointees whose services are satisfactory may be allowed the temporary increase granted by Congress of $20 a month. On account of the needs of the service, papers will be rated promptly and certification made as the needs of the service require. In the absence of further notice, applications will be received by the Commission at Washington, D. C., until the hour of closing business on Oct. 1, 1920. If sufficient eligibles are obtained, the receipt of applications may be closed before that date, of which due notice will be given. Applicants must have reached their eighteenth birthday on the date of making oath to the application. Apply for Form 1312, stating the title of the examination desired.

Trade News

The shipment of two 2800-hp. Parsons steam turbines by the Midwest Engine Co. of Indianapolis to the Asano Ship Building Co. at Yokahoma, Japan, is announced as a part of an order for a number of these turbines from the same company. The units are bladed right and left handed, designed for twin screw propellers running in port and starboard directions, and develop their maximum horsepower at 3600 r.p.m. These turbines are of the compound direct connected type, embracing a high-pressure and a low-pressure unit and they weigh, complete with pipe and gear reduction mechanism, a total of 31,780 lb.

The Pratt & Cady Co., Inc., Hartford, Conn., have just issued a new booklet on Davis hot water service heaters, and state that they will be glad to send a copy to anyone interested.

Girtanner Standardized Steam Ash Conveyor is the subject of a catalog published by Girtanner Engineering Corp., 1400 Broadway, New York, who will be glad to send a copy of this new catalog to anyone interested.

The Shuveloder, manufactured by the Lake Superior Loader Co., Duluth, Minn., is described as to construction and operation in a new bulletin which also lists a number of performance records showing the comparative cost of hand and machine shoveling.

Miniature catalog 4-A-1, giving a complete list of distribution transformers with list prices, has just been issued by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Distributed-shell, rectangular-core, and simple-shell construction with auxiliary apparatus has been outlined clearly. Single-phase, 25 and 60-cycle and three-phase 60-cycle transformers oil-insulated and self-cooled, with their voltage ratings have been listed. The standardization of distribution transformers by various associations is discussed.

Bulletin No. 1130, just issued by The Griscom-Russell Co., 90 West St., New York, deals with the Bundy oil separator, discussing design, construction, method of cleaning and directions for installation.

Pennsylvania Pump & Compressor Co. Bulletin No. 100, covering Pennsylvania, Class 3-A power drive, single-stage, straight-line air compressors, describes a new type of ring plate valve, and an oil float gage for determining, at all times, the level of oil in the crank basin, and other improved features of design embodied in this class of compressors.

The Department of Interior, Bureau of Mines, Washington, D. C., has recently issued the following papers which are of interest to power plant engineers: Technical Papers 235, The Safe Storage of Coal, by H. H. Stoek; and 253, Effects of Gasoline Removal on the Heating Value of Natural Gas, by Donald B. Dow. These publications may be obtained free of charge by addressing the department.

A new Crescent circular entitled "Modern Scientific Methods in Belt Joining" contains practical belt-joining data so designed that when opened up and tacked to a wall, it presents on one page full information for joining the belt to insure its best service under all conditions of work.

Copies of this illustrated circular, Form N. Y. 227, will be sent to any interested who address Department No. 84 of Crescent Belt Fastener Co., 381 Fourth Ave., New York.

Portable Machinery Co., Passaic, N. J., has just published a 24 page catalog entitled, "Portable Conveyors." This is complete with illustrations showing the various uses of the scoop conveyor and other portable conveyors manufactured by them, and describes clearly the labor, time and money saving features of the machines in storing, reclaiming, loading and unloading material such as coal, coke, ashes, sand, gravel, crushed stone, fertilizer, cement, chemical, etc.

Copies of the catalog will be sent free upon request to the manufacturers at the address given above.

The Westinghouse Electric & Manufacturing Co. has issued miniature catalog 3-A-1, which describes and illustrates its line of watthour meters. In this booklet, the following instruments are described as to the operation, distinctive features, construction and application: Type OA watthour meters for alternating-current service; type OA prepayment watthour meters, type RO watthour demand meters (single-phase and polyphase), type RA recording-demand watthour meters (polyphase), type RH thermal demand meters, type CW-6 watthour meters and portable standard watthour meters.